PB81-127516

Northern Puget Sound Marine Mammals

(U.S.) National Marine Fisheries Service
Seattle, WA

Prepared for

Environmental Protection Agency
Washington, DC

Jul 80

U.S. Department of Commerce
National Technical Information Service
NTIS

TECHNICAL REPORT DATA

(Please read instructions on the reverse before completing)

1. REPORT NO. EPA-600/7-80-139
2\.
3. RECIPIENT'S ACCESSION NO. PB81 127516
4. TITLE AND SUBTITLE NORTHERN PUGET SOUND MARINE MAMMALS
5. REPORT DATE July 1980 issuing date
6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Robert D. Everitt, Clifford H. Fiscus, and Robert L. DeLong
8. PERFORMING ORGANIZATION REPORT NO. NOAA Report No.
9. PERFORMING ORGANIZATION NAME AND ADDRESS

National Marine Mammal Laboratory, National Marine
Fisheries Service, N.O.A.A.
7600 Sand Point Way N.E.
Seattle, Washington 98115

10. PROGRAM ELEMENT NO. EHE 625-A
11. CONTRACT/GRANT NO. IAG No. D6-E693-EN
12. SPONSORING AGENCY NAME AND ADDRESS

U.S. Environmental Protection Agency
Office of Research & Development
Office of Environmental Engineering and Technology
Washington, D. C. 20460

13. TYPE OF REPORT AND PERIOD COVERED Final Report Nov. 77-Sep. 79
14. SPONSORING AGENCY CODE EPA-600/17
15. SUPPLEMENTARY NOTES This project is part of the EPA-planned and coordinated Federal Interagency Energy/Environment R&D Program
16. ABSTRACT

A baseline study of the marine mammals of northern Puget Sound and the Strait of Juan de Fuca was undertaken from November 1977 to September 1979 emphasizing certain aspects of the biology of the harbor seal, which is the most abundant marine mammal in this area. The local abundance and distribution of 21 species of marine mammals identified in these waters is presented.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Ecology Environments		

18. DISTRIBUTION STATEMENT Release unlimited
19. SECURITY CLASS (This Report) Unclassified
20. SECURITY CLASS (This page) Unclassified
21. NO. OF PAGES
22. PRICE

PB81-127516

DOC

United States
Department of
Commerce

National Oceanic and Atmospheric
Administration
Seattle WA 98815

EPA

United States
Environmental Protection
Agency

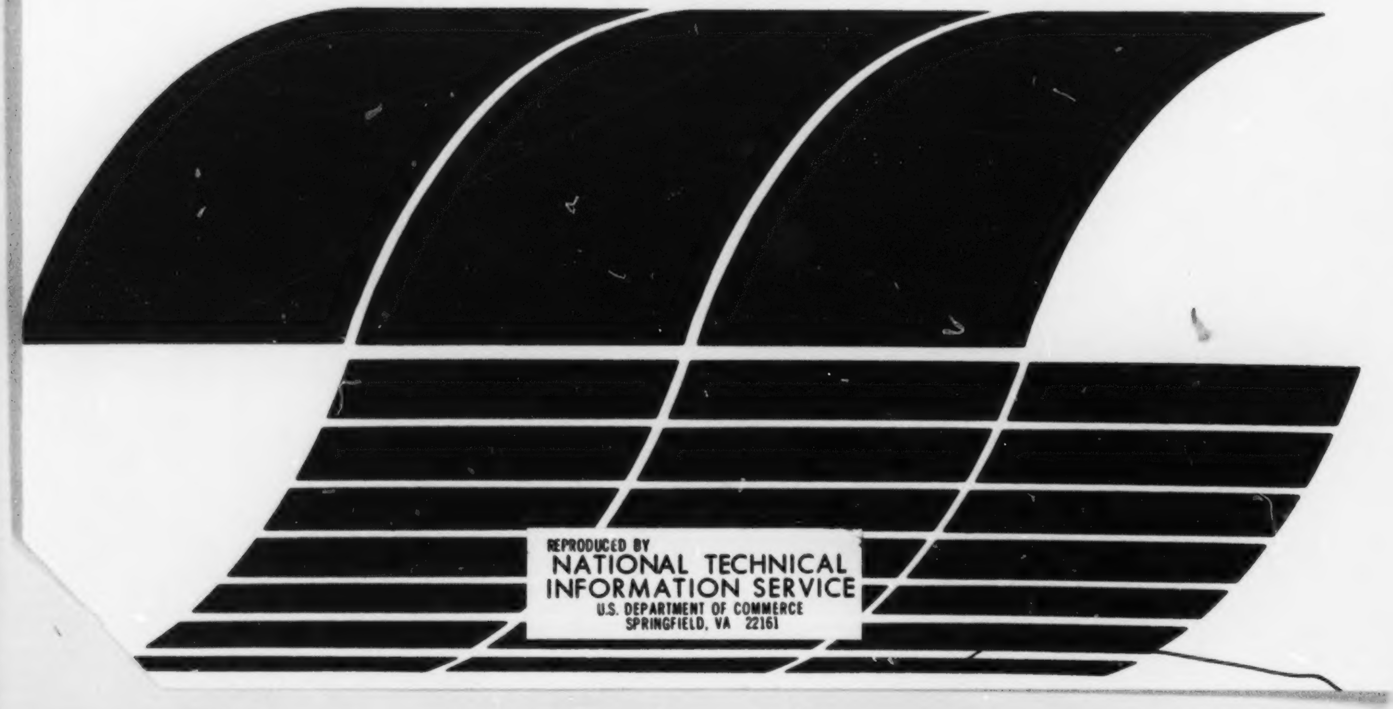
Office of Environmental
Engineering and Technology
Washington DC 20460

EPA 600/7-80-139
July 1980

Research and Development

Northern Puget Sound Marine Mammals

Interagency Energy/Environment R&D Program Report



REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA 22161

RESEARCH REPORTING SERIES

Research reports of the Office of Research and Development, U.S. Environmental Protection Agency, have been grouped into nine series. These nine broad categories were established to facilitate further development and application of environmental technology. Elimination of traditional grouping was consciously planned to foster technology transfer and a maximum interface in related fields. The nine series are:

1. Environmental Health Effects Research
2. Environmental Protection Technology
3. Ecological Research
4. Environmental Monitoring
5. Socioeconomic Environmental Studies
6. Scientific and Technical Assessment Reports (STAR)
7. Interagency Energy-Environment Research and Development
8. "Special" Reports
9. Miscellaneous Reports

This report has been assigned to the INTERAGENCY ENERGY-ENVIRONMENT RESEARCH AND DEVELOPMENT series. Reports in this series result from the effort funded under the 17-agency Federal Energy/Environment Research and Development Program. These studies relate to EPA's mission to protect the public health and welfare from adverse effects of pollutants associated with energy systems. The goal of the Program is to assure the rapid development of domestic energy supplies in an environmentally-compatible manner by providing the necessary environmental data and control technology. Investigations include analyses of the transport of energy-related pollutants and their health and ecological effects; assessments of, and development of, control technologies for energy systems; and integrated assessments of a wide range of energy-related environmental issues.

This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161.

EPA-600/7-80-139
July 1980

NORTHERN PUGET SOUND MARINE MAMMALS

by

Robert D. Everitt, Clifford H. Fiscus, and Robert L. DeLong

National Marine Mammal Laboratory
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
7600 Sand Point Way N.E.
Seattle, Washington 98115

Prepared for the MESA (Marine Ecosystems Analysis) Puget Sound Project,
Seattle, Washington in partial fulfillment of the
EPA Interagency Agreement No. D6-E693-EN
and Program Element No. EHE625-A

EPA Project Officer: Clinton W. Hall (EPA/Washington, D. C.)
NOAA Project Officer: Howard S. Harris (NOAA/Seattle, WA)

This study was conducted
as part of the Federal
Interagency Energy/Environment
Research and Development Program

Prepared for

OFFICE OF ENERGY, MINERALS, AND INDUSTRY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

Completion Report Submitted to
PUGET SOUND ENERGY-RELATED RESEARCH PROJECT
MARINE ECOSYSTEMS ANALYSIS PROGRAM
ENVIRONMENTAL RESEARCH LABORATORIES

by

National Marine Mammal Laboratory
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
Seattle, Washington 98115

This work is the result of research sponsored by the Environmental Protection Agency and administered by the Environmental Research Laboratories of the National Oceanic and Atmospheric Administration.

The Environmental Research Laboratories do not approve, recommend, or endorse any proprietary product or proprietary material mentioned in this publication. No reference shall be made to the Environmental Research Laboratories or to this publication furnished by the Environmental Research Laboratories in any advertising or sales promotion which would indicate or imply that the Environmental Research Laboratories approve, recommend, or endorse any proprietary product or proprietary material mentioned herein, or which has as its purpose an intent to cause directly or indirectly the advertised product to be used or purchased because of this Environmental Research Laboratories publication.

FOREWORD

Increased petroleum transfer and refining activities are expected in northern Puget Sound and the Strait of Juan de Fuca in the future, which will also increase the chance of oil spills into the marine environment. A study of local marine mammal populations in this region was undertaken to identify areas of major biological importance. This research was conducted by the National Marine Mammal Laboratory, NWAFC, Seattle, Washington of the National Marine Fisheries Service and was a part of a larger environmental assessment of the area funded by the U.S. Environmental Protection Agency and administered by the Marine Ecosystem Analysis Puget Sound Project Office, Seattle, Washington (a part of NOAA).

ABSTRACT

A baseline study of the marine mammals of northern Puget Sound and the Strait of Juan de Fuca was undertaken from November 1977 to September 1979 emphasizing certain aspects of the biology of the harbor seal, which is the most abundant marine mammal in these waters. Additionally, abundance and distribution of 21 species of marine mammals identified in these waters is presented.

Spring and summer months are the period when marine mammals in these waters may be most vulnerable to environmental perturbations. Study areas of importance in descending order are: the eastern Strait of Juan de Fuca, the San Juan Islands (Haro Strait and Rosario Strait), eastern bays and tideflat areas, and the western Strait of Juan de Fuca.

Of the five species of pinnipeds present, only the harbor seal occurs throughout the year in significant numbers. The largest numbers of animals hauled out were counted during the late summer-early fall molting period. In August 1979, over 2,000 harbor seals were counted, an increase over the previous year's count (1600) which was attributable to better local survey conditions. Average annual pup production was more than 19% (estimated from aerial surveys). Human disturbances, primarily from pleasure boats, may be responsible for modifying hauling behavior at Protection Island and other haul sites in the study area.

The California and northern sea lion are both present seasonally, appearing in the study area in October and departing by June. Less than 300 sea lions (both species) were counted during peak abundance periods.

Fifteen species of cetaceans are documented for these waters, though most are considered rare or accidental. Of the five common species - gray whale, minke whale, killer whale, harbor porpoise, and Dall's porpoise - most appear to occur with greatest frequency in spring and summer months. The exception to this is the gray whale which is most abundant offshore during seasonal migrations south (Nov.-Dec.) and north (Feb.-March).

The only mustelid discussed, the river otter, is common throughout the year in most parts of the study area.

TABLE OF CONTENTS

Page

FOREWORD iii

ABSTRACT iv

TABLES viii

FIGURES xii

ACKNOWLEDGEMENTS xv

INTRODUCTION 1

CONCLUSIONS 4

RECOMMENDATIONS 6

METHODS AND MATERIALS 8

Study area 8

Aerial survey 10

Small boat-land surveys 11

Sightings from other sources 11

Tagging 12

Data archival 12

RESULTS 13

SPECIES ACCOUNTS 15

Order: Carnivora 15

River otter (*Lutra canadensis*) 15

California sea lion (*Zalophus californianus californianus*). 18

Northern sea lion (*Eumetopias jubatus*) 21

Page

Northern fur seal (*Callorhinus ursinus*) 25
Harbor seal (*Phoca vitulina richardsi*) 28
    Feeding habits 29
    Reproduction 32
    Distribution 36
    Population estimation 36
    Washington State Population 42
    Harbor seal tagging and marking experiment 42
Northern elephant seal (*Mirounga angustirostris*) 44
Order Mysticeti 48
Gray whale (*Eschrichtius robustus*) 48
Minke whale (*Balaenoptera acutorostrata*) 51
Fin whale (*Balaenoptera physalus*) 53
Humpback whale (*Megaptera novaeangliae*) 54
Order Odontoceti 55
Saddleback dolphin (*Delphinus delphis*) 55
Pacific whiteside dolphin (*Lagenorhynchus obliguidens*) . . . 56
Whitehead grampus (*Grampus griseus*) 56
False killer whale (*Pseudorca crassidens*) 57
Short-finned pilot whale (*Globicephala macrorhynchus*) . . . 57
Killer whale (*Orcinus orca*) 58
Harbor porpoise (*Phocoena phocoena*) 60
Dall's porpoise (*Phocoenoides dalli*) 62
White whale (Belukha) (*Delphinapterus leucas leucas*) . . . 64

Page

Pygmy sperm whale (Kogia breviceps) 64

North Pacific giant bottlenose whale (Berardius bairdii) . 65

Goosebeak whale (Ziphius cavirostris) 65

Beaked whales (Mesoplodon spp.) 65

DISCUSSION 67

Cetaceans 67

Mustelids 70

Pinnipeds 71

REFERENCES 77

Appendix A - Records of marine mammals sighted in study area . . 87

Appendix B - Description of harbor seal sampling units 124

TABLES

Number Page

1. A list of marine mammals reported from the waters of Puget Sound, the San Juan Island area, and the Strait of Juan de Fuca 14

2. Number of California sea lions (Zalophus c. californianus) observed hauled out at all sites in the inland waters of Washington, by month, November 1977 to December 1979. Numbers observed include both positive and tentative identifications 20

3. Observations of California sea lions (Zalophus c. californianus) at Port Gardner, Washington, May 1979 20

4. Otoliths of fish recovered from scats and a spewing of California sea lions (Zalophus c. californianus) in Port Gardner, Washington, May 1979 21

5. Number of Northern sea lions (Eumetopias jubatus) observed hauled out at all sites in the inland waters of Washington, by month, November 1977 to December 1979 23

6. Observations of Northern sea lions (Eumetopias jubatus) in the water in northern Puget Sound, San Juan Islands, and the Strait of Juan de Fuca, November 1977 to August 1979 25

7. Yearly take of Northern fur seals (Callorhinus ursinus) by Indians in Washington waters from 1913 to 1941 27

8. Species of fish identified from otoliths recovered from harbor seal scat collected on Protection Island, Washington, 1978-1979 30

9. Percentage of occurrence of important prey species represented in harbor seal scat collected at Protection Island, WA, in 1978-1979 31

10. Harbor seal pupping areas in northern Puget Sound and the Strait of Juan de Fuca, 1978-1979. The percentage of pups represented in the total count for each haul out site is given, as is the maximum count for each site obtained during the two year survey period 34

Tables, cont.

Number Page

11. Type of disturbance resulting in harbor seals entering the water from the haul site at Protection Island, June-April 1979. 38

12. Maximum counts of harbor seals obtained during aerial surveys of the Strait of Juan de Fuca, northern Puget Sound, the San Juan Islands, and the eastern bays, November 1977 to August 1979, summarized by sampling units. 41

13. High counts of harbor seals in Washington waters, 1975-1979. Counts include pups. 43

14. Occurrence of cetaceans described as common in the study area by geographical regions during the four seasons of the year. 68

15. Relative importance of geographical regions in the study area to cetaceans. 71

16. Seasonal variations of the harbor seal population in the five regions of the study area expressed as a percent of total population. 75

17. Occurrence of pinnipeds described as common in the study area by geographical regions during the four seasons of the year. 76

Appendix A Tables

Number Page

A-1 Numbers of Northern sea lions, California sea lions, and sea lions (species undetermined) at Race Rocks, British Columbia from December 1978 to December 1979. Counts from aerial photographs, except October to December 1979 from vessels. 88

A-2 Numbers of harbor seals sighted on aerial surveys of the islands, islets, and rocks of the San Juan Wilderness area, December 1978 through May 1979. 89

A-3 Numbers of harbor seals sighted on aerial surveys of the islands, islets, and rocks of the San Juan Wilderness area, June through August 1979. 93

A-4 Numbers of harbor seals sighted on aerial surveys from northern Puget Sound to Bellingham Bay and the San Juan Islands (excluding San Juan Wilderness sites), December 1978 through May 1979. 96

A-5 Numbers of harbor seals sighted on aerial surveys from northern Puget Sound to Bellingham Bay and the San Juan Islands (excluding San Juan Wilderness sites), June through August 1979. 97

A-6 Numbers of harbor seals sighted on aerial surveys from the Strait of Juan de Fuca, December 1978 through May 1979. . 98

A-7 Numbers of harbor seals sighted on aerial surveys from the Strait of Juan de Fuca, June through August 1979. 99

A-8 Sighting reports of northern elephant seals (*Mirounga angustirostris*) in Puget Sound, the San Juan Islands, and the Strait of Juan de Fuca, by month. 100

A-9 Sighting reports of gray whales (*Eschrichtius robustus*) in Puget Sound, the San Juan Islands, and the Strait of Juan de Fuca, by month. 103

A-10 Sighting reports of minke whales (*Balaenoptera acutorostrata*) in Puget Sound, the San Juan Islands, and the Strait of Juan de Fuca, by month. 107

A-11 Sighting reports of harbor porpoise (*Phocoena phocoena*) in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca, by month. 112

Appendix A Tables cont.

Number Page

A-12 Sighting records of Dall's porpoise (*Phocoenoides dalli*) in Puget Sound, the San Juan Islands, and the Strait of Juan de Fuca, by month. 116

Appendix B Tables

Number Page

B-1 Counts of harbor seals in Bellingham Bay by MESA Seabird study observers. 127

B-2 Observations of harbor seals in Port Angeles harbor, 1978-1979. 132

FIGURES

Number Page

1. The waters of Puget Sound, the San Juan Islands, and the Strait of Juan de Fuca. 2

2. Major geographical regions and local area units in northern Puget Sound and the Strait of Juan de Fuca. 9

3. Locations where river otters (*Lutra canadensis*) were sighted or trapped in Puget Sound, the San Juan Islands, and the Strait of Juan de Fuca. 17

4. Monthly high counts of Northern sea lions (*Eumetopias jubatus*) and California sea lions (*Zalophus c. californianus*) observed in Washington 1976-1978. 24

5. Locations of known haul out sites of harbor seals (*Phoca vitulina richardsi*) in the study area. 37

6. Observed disturbance of harbor seals at the Protection Island haulsite, June-August 1979 by (A) day of the week, and (B) time of day. 38

7. Dates harbor seals were marked and tagged at Protection Island, Washington in 1979 and later resighted. 45

8. Locations where elephant seals (*Mirounga angustirostris*) were sighted in Puget Sound, the San Juan Islands, and the Strait of Juan de Fuca. 47

9. Locations where gray whales (*Eschrichtius robustus*) were sighted in Puget Sound, the San Juan Islands, and the Strait of Juan de Fuca (Table A-9). 50

10. Locations where minke whales (*Balaenoptera acutorostrata*) were sighted in Puget Sound, the San Juan Islands, and the Strait of Juan de Fuca (Table A-10). 52

11. Locations where harbor porpoise (*Phocoena phocoena*) were sighted in Puget Sound, the San Juan Islands, and the Strait of Juan de Fuca (Table A-11). 61

Figures, cont.

Number | Page

12. Locations where Dall's porpoise (Phocoenoides dalli), were sighted in Puget Sound, the San Juan Islands, and the Strait of Juan de Fuca (Table A-12). 63

13. Highest monthly counts of gray whales in Puget Sound, the San Juan Islands, the Strait of Juan de Fuca, and Washington coastal waters, 1976-79. 69

14. Seasonal abundance of Northern and California sea lions in the study area, 1977-1979; 1977-78 (--), 1978-79 (-), except Nov. and Dec. 1979 counts which are shown as (▲▽). . . . 73

Appendix A Figures

Number Page

A-1 Locations of islands, islets, and rocks of the San Juan Wilderness area. 122

A-2 Locations of harbor seal (*Phoca vitulina richardsi*) haul out sites from northern Puget Sound to Bellingham Bay, the San Juan Islands (excluding San Juan Wilderness sites), and the Strait of Juan de Fuca. 123

ACKNOWLEDGEMENTS

We wish to express our gratitude to the many people who contributed to this research effort. Funding was provided by EPA and administered through the MESA Puget Sound Project Office, Seattle, Washington.

T. Bray, J. Calambokidis, G. Carroll, P. Cole, J. Cubbage, R. Deede, R. Dickinson, R. Fritzen, P. Gearin, B. Hacker, W. Harrington, S. Hill, K. Hirsch, S. Jeffries, E. Long, P. McGuire, R. Mercer, C. Peterson, K. Raedeke, M. Rauzon, D. Rugh, N. Severinghaus, K. Wilson, D. Withrow, and A. Wolman all participated as observers for one or more of the aerial surveys. Help with boat surveys was provided by J. Cubbage, T. Coralline, R. Dickinson, R. Fritzen, B. Krogman, S. Minzelli, K. Raedeke, M. Dahlheim, S. Mizrock, J. Francis, G. Antonelis, K. Hirsch, J. Skidmore, S. Jeffries, U. Wilson, and J. Joyce.

Personnel of the Nisqually Wildlife Refuge, U.S. Fish and Wildlife Service, Olympia, Washington allowed access to Dungeness Wildlife Refuge and the San Juan Wilderness area. D. Manuwal, S. Speich, T. Wahl, and R. Taber of the Wildlife Sciences group, College of Forest Resources, University of Washington, Seattle, Washington, provided data from their own work and stimulating dialogues throughout the planning and implementation of this study. R. Hirschi, Washington State Department of Game, Seattle, Washington contributed his expertise. The Moclips Cetological Society allowed the use of their data and provided logistic support; particular help was provided by K. Balcomb, J. Boran, and R. Osborne. K. Kenyon and T. Newby contributed advice and guidance. J. Fitch, California Fish and Game, and T. Crawford, NMML, identified fish otoliths recovered from scat. Mr. and Mrs. Corraline, as caretakers of Protection Island, supplied logistic support and use of island facilities in 1978, and Mr.and Mrs. Davis provided similar help during the 1979 field season. Mr. and Mrs. Dahlheim provided the "R.V. Dahlheim" for vessel surveys. Mr. and Mrs. Stirling helped to make us feel at home on Protection Island.

Help and advice of the staff at the Marine Mammal Division, NWAFC, Seattle, Washington is gratefully acknowledged. P. Gearin, University of Washington, was a valuable and competent field assistant in 1979. His interest and enthusiasm for the project greatly increased our data collecting efforts.

Attempts to capture harbor seals were made by J. Babson, R. Dickinson, R. Fritzen, P. Gearin, S. Jeffries, E. Long, P. Morley, S. Savage, J. Skidmore, and the Stirlings. Their advice and assistance is gratefully acknowledged.

I. INTRODUCTION

The Strait of Juan de Fuca, the San Juan Islands vicinity, and Puget Sound are unique waterways ideal for commercial and recreational use (Fig. 1). Growth of the human population in this area and continued development, however, have caused increasing concern over potential environmental degradation. Recent concern has been focused on the effect of increasing petroleum transport and associated refining operations on Puget Sound. The development of Alaska's oil reserves and consideration of Washington as a point of departure for transshipment of petroleum products to other areas of the country have also increased the possibility of environmental degradation.

In response to these threats, research has begun to document the effects of certain types of development on the biological resources of Puget Sound and provide some baseline information. This research, which has been funded partly by the U. S. Environmental Protection Agency (EPA) and administered through the National Oceanic and Atmospheric Administration's (NOAA) Marine Ecosystems Analysis (MESA) Puget Sound Project Office, is designed to develop an understanding of the ecosystem of Puget Sound and the Strait of Juan de Fuca, to compile baseline data for these waters, and to identify the potential consequences of petroleum transport and transfer operations.

As part of this larger effort, a MESA funded study of the distribution and abundance of marine mammals in northern Puget Sound and the Strait of Juan de Fuca was conducted through NOAA's National Marine Mammal Laboratory (NMML) located at the Northwest and Alaska Fisheries Center (NWAFC), National Marine Fisheries Service (NMFS), Seattle, Washington. The objectives of this study were to: (1) determine the relative seasonal abundance of each species of marine mammal in the study area, (2) describe specific locations used regularly by these populations, and (3) characterize the various populations and their habits which may increase their vulnerability to petroleum-related activities.

A description of research activities and data generated in pursuing these objectives from November 1977 to January 1980 is presented in this report with our final results and conclusions. Some information, reported in detail in Everitt et al. (1979), the project annual report for 1977-1978, is also provided. In that document marine mammals known to occur in the inland waters of Washington are discussed in considerable detail, including relevant natural history (e.g., biological description, behavior, reproduction, feeding habits, and known predators), distribution and abundance (worldwide and locally), and ecological problems (e.g., fishery interactions and effects of pollutants or harassment). In addition, literature of the physiological effects of oil on marine mammals is reviewed in Everitt et al. (1979).

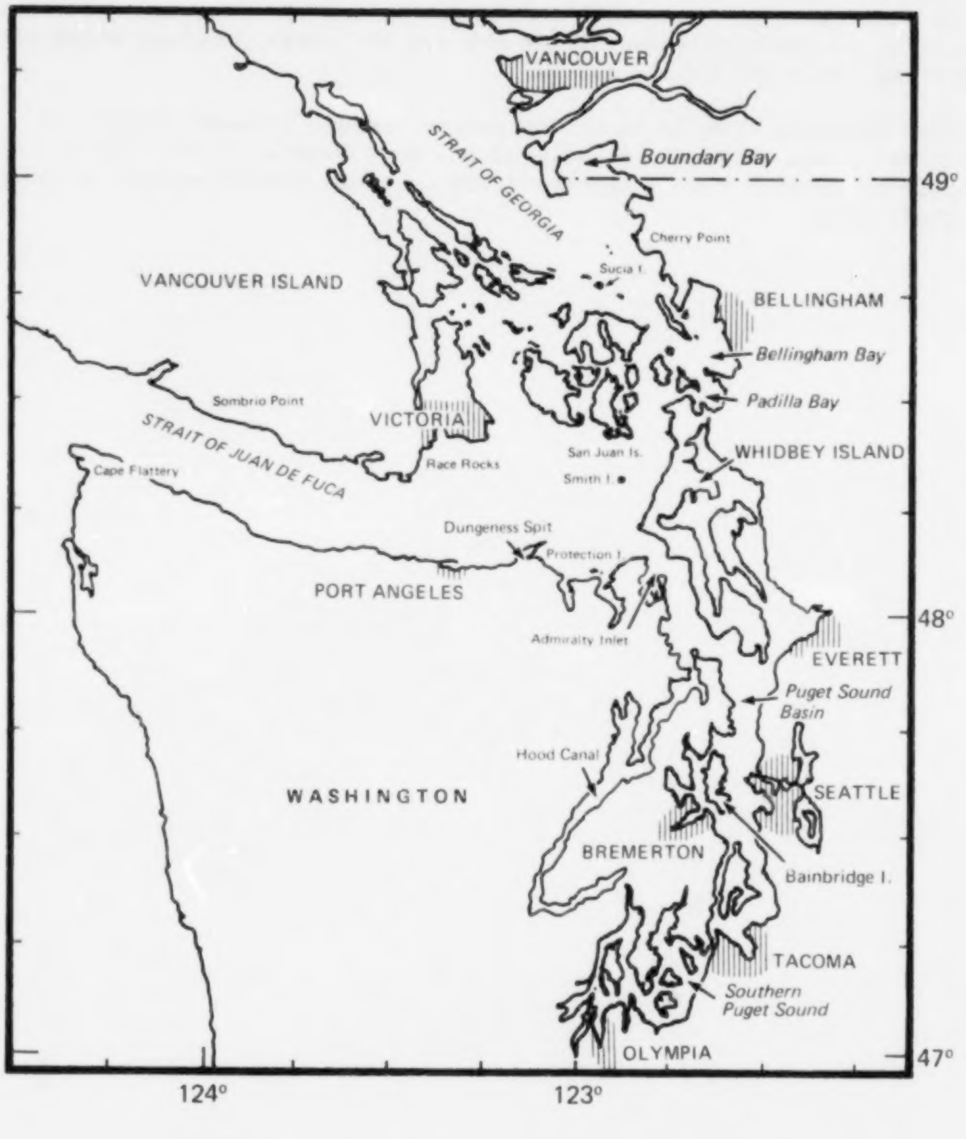

VANCOUVER
Boundary Bay
49°
STRAIT OF GEORGIA
Cherry Point
Sucia I.
VANCOUVER ISLAND
BELLINGHAM
Bellingham Bay
Padilla Bay
Sombrio Point
VICTORIA
STRAIT OF JUAN DE FUCA
Race Rocks
San Juan Is.
WHIDBEY ISLAND
Cape Flattery
Smith I.
Dungeness Spit
Protection I.
PORT ANGELES
48°
Admiralty Inlet
EVERETT
Puget Sound Basin
Hood Canal
SEATTLE
WASHINGTON
BREMERTON
Bainbridge I.
TACOMA
Southern Puget Sound
OLYMPIA
47°
124°
123°

Figure 1. The waters of Puget Sound, the San Juan Islands and the Strait of Juan de Fuca.

An excellent summary of our present knowledge of the direct effects of oil on marine mammals was prepared by Geraci and St. Aubin (1979). Briefly, fouling by oil of baleen plates of the Mysticeti and ingestion of oil in all species of Cetaceans appears to be potentially the most dangerous. Fouling of fur would endanger the otter and fur seal, and the ingestion of oil and irritation to delicate membranes of the eye and nasal passages would adversely affect sea lions and phocid seals.

The indirect effects of oil on marine mammals through changes in structure of the food web, as pointed out by Simenstad et al. (1979), may possibly be greater than a direct effect on those marine mammals inhabiting the study area.

CONCLUSIONS

Twenty-one species of marine mammals have been reported in northern Puget Sound and the Strait of Juan de Fuca. Marine mammals in these waters are most abundant and reproductively active--and thus more vulnerable to oil pollution and harassment--during spring and summer months. The most significant localities appear to be the eastern Strait of Juan de Fuca, Haro Strait, and to a lesser degree, Rosario Strait. Major human activities that would result in large scale disturbance (e.g., major construction operations) in these localities should be timed to avoid these critical biological times.

Only five of the fifteen species of cetaceans reported in these waters are considered as occurring regularly; they are the gray whale, minke whale, killer whale, harbor porpoise, and Dall's porpoise. The gray whale, and to an unknown degree the minke whale, appear seasonally in small numbers. Dall's porpoise are present throughout the year and are probably most abundant in spring. The killer whale, numbering at least 80 animals in this area, and the harbor porpoise, status unknown, are present year-round. Reproductive activities, calving, and nursing of these two species occur in spring and summer and represent critical periods in their annual cycle. During the summer and fall these species are probably most abundant in the eastern Strait of Juan de Fuca and Haro Strait.

Of the five species of pinnipeds found in these waters, only three, the California sea lion, northern sea lion, and Pacific harbor seal, occur in significant numbers. Both species of sea lions appear seasonally from October to May with peak abundance of about 250 animals occurring from December to March. Nearly all of these animals are regularly found at Race Rocks, Vancouver Island, British Columbia, in the eastern Strait of Juan de Fuca. The effect of oil and disturbance on sea lions is unknown, but any adverse effects on so few animals locally would not seriously affect the two stocks.

The harbor seal is the most abundant marine mammal in the study area and the only breeding pinniped. Over 55 haul sites, distributed throughout the study area, have been identified. Location of haul sites may be dependent on a number of factors including freedom from disturbance, seasonally abundant prey, and the suitability of the site for pupping, reproduction, and molting. Pups are born from June to August at nearly all sites and the average reproductive rate (based on aerial survey counts) was 19.8%. The highest count of harbor seals was 2,179 animals taken in August 1979. The largest haul out sites and most significant reproduction takes place in the eastern Strait of Juan de Fuca. Harbor seals are highly susceptible to disturbance. The most critical time is during the pupping season when disturbance may separate mother-pup pairs. The direct effects of oil on this species are inconclusive, but would probably be most detrimental during the breeding and pupping periods. It is not known if seals displaced from a habitat (e.g., due to shoreline development or loss of a food resource) would reestablish themselves in other areas.

RECOMMENDATIONS

1. Use the harbor seal as a control species to monitor its response to changes in the ecosystem of the study area.

The most abundant and most easily observed marine mammal in Washington is the harbor seal. We recommend that an ongoing monitoring program of this population, in at least a few important areas (Dungeness Bay, Protection Island, and Minor Island), be instituted. Such a program should consist of:

a. Regular aerial surveys of these sites during the period of maximum pup production (August) and/or during the molting period when maximum numbers are expected ashore (August-September). If surveys of the entire area are not possible (due either to time or budget constraints), partial surveys could be made emphasizing those sites listed in the preceding paragraph in the eastern Strait of Juan de Fuca and the San Juan Islands.

b. On-site evaluation of productivity, activity patterns, effect of disturbances, and collection of dead animals should continue at the important breeding site(s). Protection Island and Smith-Minor Islands warrant the closest scrutiny. Logistically, the population on Protection Island may be the easiest and least expensive to study. Assuming that recreational development on Protection Island continues, the (presumed) loss of Violet Point as a breeding and hauling area should be documented.

c. A tagging program should be continued to answer such important questions as: proportion of animals ashore (for use in making population estimates), site fidelity, survival rates, activity budgets, and extent of movements between haul sites and regions.

d. Analyze fat and muscle tissue of dead seals collected through stranding network to detect changes in pollutant levels of area.

2. Continued support of photogrammetric studies of local killer whale populations.

a. There are few populations of cetaceans in the world so accessible for study at such a minimal cost. Present procedures to collect data from individually known whales should be continued. Their response to environmental changes in the region could serve as another indicator of the overall health and vitality of marine organisms of the region.

b. A public response, toll-free telephone line to receive reports of cetaceans and pinnipeds should be continued (this system, presently maintained by the Moclips Ceteological Society, is popularly known as "Whale Hot Line"). Reports tend to be more frequent and of higher quality when the system is heavily advertised (Boran et al. 1979), thus continuation of the system should also include advertising.

3. Observations from ships.

a. The Platforms of Opportunity Program (POP), which collects and archives marine mammal observations made from cooperating vessels at sea, should continue and encourage vigilance of observers aboard while passing through Puget Sound.

b. NOAA vessels that are operating in Washington waters, or become available for limited, dedicated use, should have a trained marine mammal observer aboard.

METHODS AND MATERIALS

A research strategy was devised using several different methodologies to obtain data on marine mammals in the study area. Direct censusing of the large populations of pinnipeds, which are easily observed, was undertaken. Records and observations from published and unpublished sources provided information on those marine mammals which were not observed during field activities or are infrequent or rare visitors to the study area.

Study Area

The research area encompasses the waters of the Strait of Juan de Fuca and northern Puget Sound (lat 48° to 49°N and long 122°30'W to 124°50'W), see Figure 1. The San Juan Archipelago consists of over 180 major and minor islands, islets, and reefs. Large tideflat areas are found in Padilla, Skagit, Bellingham, and Samish Bays. Long sand and cobble spits occur at Protection Island, Dungeness Spit, and Minor Island. A study site was established on Protection Island.

For the purposes of summarizing species abundance and distribution data, the study area was subdivided into five geographical regions. More data were collected on a few species of pinnipeds (California sea lion, northern sea lion, and harbor seal) than for other marine mammals in the study area. These species were additionally summarized in 17 local units of area (Fig. 2).

A brief description of these regions follows; the numbers in parenthesis refer to one or more of the 17 units established in the study area.

Region I--The western Strait of Juan de Fuca (units 13-16), extends from Tatoosh Island east to Angles Point on the Olympic Peninsula and from San Juan Point to Church Point on Vancouver Island. Both U.S. and Canadian coastlines are included, as are the open waters of the Strait of Juan de Fuca.

Region II--The eastern Strait of Juan de Fuca (units 7, 9-12, 17). Extends from Angeles Point east to Whidbey Island and from Discovery Island (British Columbia) east to Deception Pass but south of the San Juan Archipelago. The British Columbia coastline, islands, and islets from Bentinck Island to Discovery Island are included, as are the open water areas.

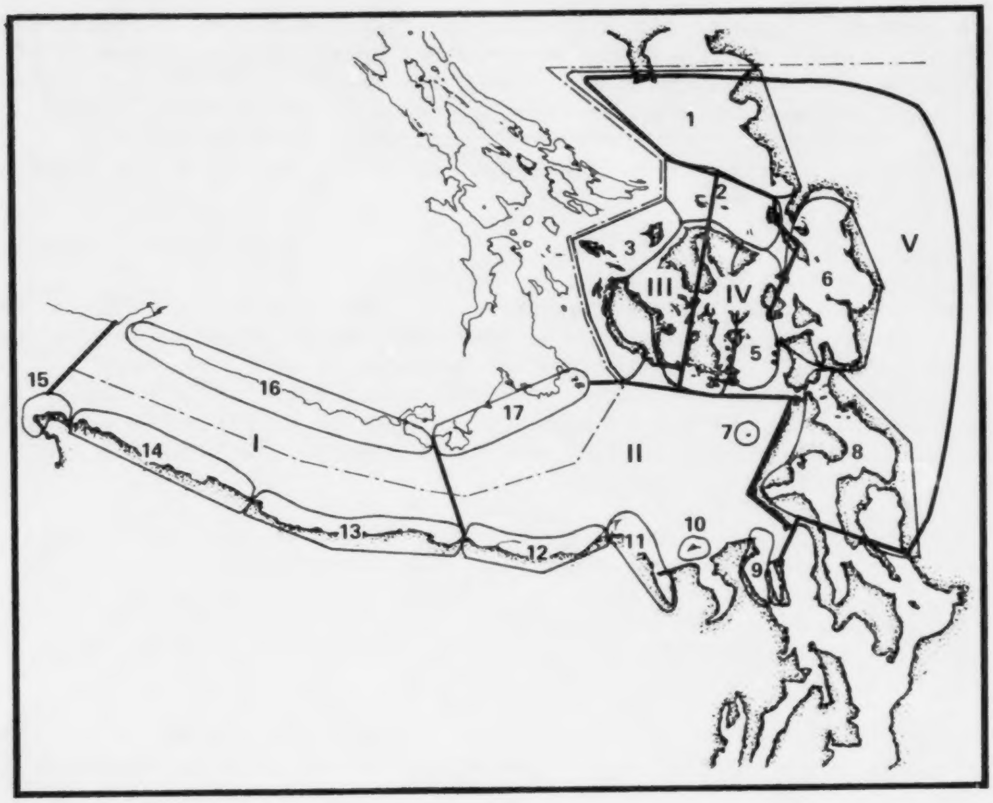

1
2
3
III
IV
5
6
V
7
8
II
9
10
11
12
13
14
15
16
I
17

Figure 2. Major geographical regions and local area units in Northern Puget Sound and the Strait of Juan de Fuca.

Region III--Haro Strait (units 2-3). Extends from False Bay, San Juan Island, along the U.S. side of Haro Strait to Point Migley, Lummi Island.

Region IV--Rosario Strait (unit 5). Includes all of Rosario Strait from Deception Pass to Point Lawrence, Orcas Island.

Region V--Eastern Bays (units 1, 6, 8). Includes all the tidal bays in northern Puget Sound from Birch Bay to Port Susan. Bays of primary importance to the present study were: Bellingham, Samish, Padilla, and Skagit.

Aerial Survey

Aerial survey is the technique most used to census marine mammal populations (Eberhardt et al. 1979) and is particularly effective for pinnipeds which haul out on land and are readily visible. During the study, 219.1 hours were flown in 59 flights.1/ Usually two observers (in addition to the pilot) participated in each flight. The primary observer sat forward next to the pilot and directed the survey, made visual estimates of numbers of animals observed, and photographed all groups of pinnipeds or cetaceans when possible. Other observers sat aft and maintained observation and location records. Surveys were timed to coincide with monthly low tides. The entire study area was covered, usually in 2 or 3 days; coastal surveys were flown at altitudes of 300-500 feet and open water transects at about 700 feet.

Photographs of hauled out animals were taken with a 35 mm single reflex camera with motor drive unit and 105, 135, or 200 mm lenses with automatic aperture control. Overlapping photographs were taken if more than one photograph was required for complete coverage of assembled animals. High speed Kodak (ASA 200) ektachrome2/ film was used because dark overcast conditions and high flight speeds (120 mph) required the use of low aperture stops and shutter speeds of 1/250 of a second or faster. The developed slides were projected onto a large roll of white paper for counting animals, and images were marked to avoid duplication. These photographic counts replaced corresponding visual estimates in the field notes.

Since several days were required to survey the study area each month, the possibility of an animal occurring on successive days at different sites

---

1/ Aerial surveys were conducted using a four place Cessna 172 aircraft chartered from Bison Air, Seattle, Washington from November 1977 to March 1978, and from Air-Eze Ltd., Seattle, Washington from April 1978 to September 1979.

2/ Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

and thus being counted twice occurs. This factor cannot be evaluated without an understanding of local movements of animals, which is lacking for most species of marine mammals, and for the purposes of this study duplicate sightings were considered negligible.

Small Boat-Land Observations

Occasionally locally restricted boat surveys were conducted using a 16-foot outboard skiff. During surveys at least two observers were on board, with the boat operator serving as a secondary observer. The primary observer scanned open water areas, and when in view of hauling areas made several counts aided by 7x50 mm Bushnell binoculars. The average of these counts was used as the best estimate of the number of animals present. Photographs were taken to document habitat type and to create a photo-catalogue of harbor seal haul out areas (available at NMML).

Land observations were made at Protection Island. Most observations were made from cliffs overlooking the eastern hauling area (Violet Point), using a Bushnell 20x45 zoom telescope mounted on a tripod, and from a boat anchored 50-70 m offshore. The total number of animals was recorded, age classes noted, i.e., whether adult, immature, or pup, and behavioral notes were made when practicable. Disturbance of seals on haul sites was recorded. Notes were also made on weather conditions (visibility, temperature, and wind speed and direction). Observation times varied, depending on weather conditions and suitability of observation point, but were never longer than 30 minutes. As conditions allowed, observations were made hourly through a tidal cycle. Land observations suffered primarily from the difficulty of approaching harbor seals within viewing distance without disturbing them. An unknown number of animals may always be out of view from the land, so such counts may be low.

Sightings From Other Sources

Supplemental data from other sources were invaluable additions to our own observations. Some records were obtained from published literature and reports. The Platforms of Opportunity Program (POP), which solicits sightings from NOAA research vessels, and commercial boat operators provided additional information. Other MESA funded projects, particularly the sea bird study, collected marine mammal sightings for us, and interviews with local residents and commerical fishermen produced a few new records. The Moclips Cetological Society and the general public provided data collected during the course of an ongoing study of killer whales (Orca survey) which was partially sponsored by the NMML.

For some species, abundance data were taken from the current status of the stocks of marine mammals, which appears in the Annual Reports on the administration of the Marine Mammal Protection Act of 1972 for 1978 and 1979 and are cited in the text as NMFS 1978 or 1979.

Tagging

In an attempt to gain insight into activity patterns and local movements of harbor seals on and around Protection Island, a few animals were captured and marked in 1979. Capturing harbor seals at this location proved difficult; the most successful technique consisted of "fishing" a large mesh monofilament gill net set near a kelp bed. The unweighted net allowed a tangled animal to rise to the surface to breath and reduced the possibility of injury or drowning. No mortalities occurred using this method. Similar capture techniques have been successfully employed in Netarts Bay, Oregon (Brown and Mate 1979) and Grays Harbor, Washington (Everitt and Jeffries 1979).

Once an animal became entangled, the net was hauled to shore and the animal removed, placed in a burlap head bag, tagged, measured, sexed, and released. Each animal was double tagged (rear flippers) with monel cattle ear tags and its pelage was marked with a distinct bright pattern using "Woolite" Sheep branding liquid. Due to the design of telemetry equipment, only adult animals could be fitted with ankle bracelets. The radio equipment was produced by Cedar Creek Bioelectronics Laboratory, Minneapolis, Minnesota.

Tagging operations were discontinued before the onset of the pupping season to avoid the disturbance of animals on breeding areas. Marked animals were observed from a land observation point, small boat, and aerial surveys.

Data Archival

All data collected during aerial, shipboard, and land surveys were formatted into Environmental Data Service format 027. Data were then transmitted to the MESA Puget Sound Project Office, Seattle, for eventual permanent archival with Environmental Data and Information Service in Washington, D.C.

RESULTS

The marine mammals reported from northern Puget Sound and the Strait of Juan de Fuca represent three orders (Carnivora, Mysticeti, and Odontoceti). Research was directed at those species of marine mammals which, from the literature, are known to have occurred in the inland waters of Washington. No occurrences of new species were documented during the study period. For the purpose of this report, we use the nomenclature of Rice (1977), except for the subspecific spelling of *Phoca vitulina richardsi*, Shaughnessy and Fay (1977). Rice (pers. commun.) has corrected the specific spelling of the Dall's porpoise (*Phocoenoides dallii*) to *P. dalli*. Other mammals that may on occasion feed in the intertidal area (e.g., mink [*Mustela vison*]) are not included in this study, which is limited to only those mammals that are entirely marine or, as in the case of the river otter (*Lutra canadensis*), has some segment of its population that is completely marine in the study area (e.g., San Juan Islands).

A list of marine mammals recorded in the inland Washington waters is given in Table 1. In addition to those animals listed in Table 1, the beluka (*Delphinapterus leucas*) and beaked whales (*Mesoplodon* spp.) may have been sighted in the study area and are briefly mentioned in the species accounts although chances of resighting are considered nil. Those species described as common are species that either occur throughout the year as breeding residents or regularly as seasonal migrants; those listed as rare are species that occur on a regular basis but in low numbers; and those listed as accidental are species for which only specimen records are known (often only one) and no recent live sightings have been made (Everitt et al. 1979).

Table 1.--Marine mammals reported from the waters of Puget Sound, the San Juan Island area and the Strait of Juan de Fuca.

Species	Occurrence[1/]
Order: Carnivora	
Family: Mustelidae	
River otter (*Lutra canadensis pacifica*)	C
Family: Otariidae	
California sea lion (*Zalophus californianus californianus*)	C
Northern (Steller's) sea lion (*Eumetopias jubatus*)	C
Northern fur seal (*Callorhinus ursinus*)	R
Family: Phocidae	
Harbor seal (*Phoca vitulina richardsi*)	C
Northern elephant seal (*Mirounga angustirostris*)	R
Order: Mysticeti	
Family: Eschrichtiidae	
Gray whale (*Eschrichtius robustus*)	C
Family: Balaenopteridae	
Minke whale (*Balaenoptera acutorostrata*)	C
Fin whale (*Balaenoptera physalus*)	A
Humpback whale (*Megaptera novaeangliae*)	R
Order: Odontoceti	
Family: Delphinidae	
Saddleback dolphin (*Delphinus delphis*)	A
Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)	R
Whitehead grampus (*Grampus griseus*)	A
False killer whale (*Pseudorca crassidens*)	A
Shortfinned pilot whale (*Globicephala macrorhynchus*)	R
Killer whale (*Orcinus orca*)	C
Harbor porpoise (*Phocoena phocoena*)	C
Dall's porpoise (*Phocoenoides dalli*)	C
Family: Physeteridae	
Pygmy sperm whale (*Kogia breviceps*)	A
Family: Ziphiidae	
North Pacific giant bottlenose whale (*Berardius bairdii*)	A
Goosebeak whale (*Ziphius cavirostris*)	A

[1/] C = Common R = Rare A = Accidental

SPECIES ACCOUNTS

Order: Carnivora

Some members of three families of this order inhabit the marine environment; included are 37 species, separated into 21 genera (Rice 1977). Seven of these species have been reported from the offshore, coastal, and inside waters of Washington: sea otter (Enhydra lutris), river otter (Lutra canadensis), California sea lion (Zalophus californianus californianus), northern (Steller's) sea lion (Eumetopias jubatus), northern fur seal (Callorhinus ursinus), harbor seal (Phoca vitulina richardsi), and the northern elephant seal (Mirounga angustirostris). With the exception of the river otter, these species are protected in United States waters by the Marine Mammal Protection Act of 1972 and the fur seal, in addition, by the Interim Convention on Conservation of North Pacific Fur Seals.

Six of the species reported from Washington waters have been identified from Puget Sound, the San Juan Islands, or the Strait of Juan de Fuca. These six species, reported from the study area, are discussed individually and sighting records are given.

River Otter (Lutra canadensis)

The river otter is a resident of freshwater and marine areas throughout western Washington and is a commercially valuable fur bearer (Hirschi 1978). In the San Juan Islands there are some otters that reside entirely in the marine environment.

The subspecies of river otter found in Washington, pacifica, is one of the largest of this species and is found from Oregon north along the coast to southeastern Alaska. Otters of both sexes and all ages are colored in varying shades of brown on back and sides and are lighter on the under parts. Adults reach 1.13 m with a tail of 0.38 m and weigh up to 11.4 kg. In the study area, Hirschi (1978) reports that otter feed on sculpins, flounders, crayfish, and spawning salmonids.

The river otter is often confused with the sea otter (Enhydra lutris) as both animals are similar in appearance and can occur in similar habitats. Kenyon (1969) states that sea otters never occurred with any regularity in the inland waters of Washington and that the species was eliminated from coastal Washington by over exploitation in the 19th century. The occurrence of sea otters in Puget Sound has never been verified, though many river otters in this area have erroneously been identified as sea otters. Sea otters were transplanted to Washington in the early 1970's in an attempt to reestablish a population in the state. Jameson (1977) estimates that presently there are less than 30 sea otters in coastal Washington waters. Presently, most sightings occur from Destruction Island north to Ozette Island (NMML files). Kenyon (1969) provided a checklist of characteristics to separate these two species in the field by describing certain behaviors of sea otters that do not appear in river otters, including:

1. On the surface, sea otters usually swim belly up with forepaws on chest while paddling with hind flippers. They float high in the water.

2. Are clumsy on land, seldom seen on shore except in isolated Alaskan areas.

3. Eat while floating on their backs, never eating on shore.

4. Sleep (usually) in kelp beds or calm water while floating on its back.

5. Bear single young which is carried on the mother's chest as she swims on her back.

River otters are distributed throughout the study area. Hirschi (1978) reported trapping records and personal observations of otters from northern Puget Sound, throughout the San Juan Islands, and in the Skagit River system (Fig. 3). Along the Strait of Juan de Fuca, Hirschi reported animals from the Dungeness area, Port Angeles, and Cape Flattery. During the present study, sightings of otters were made only in the San Juan Islands. Most of the new records compiled during this study came from small boat surveys or personal interviews. Only one observation was made during aerial surveys when a single otter was observed in the inter-tidal area on the north fork of the Skagit River on 24 August 1979.

Present data are insufficient for estimating numbers in the study area, but population trends are being monitored through analysis of trapping data and population profiles obtained from sampling individuals. Hirschi (1978) considers the population in western Washington to be reasonably stable at this time but suggests that a yearly harvest in excess of 600 animals cannot be sustained. A harvest of this magnitude is rare and when it occurs, trapping success in years immediately following is reduced.

River otters rely on a still air layer trapped between two fur layers for insulation, as does the sea otter and northern fur seal (Callorhinus ursinus). Oiling of the fur, which would occur if the otter contacted spilled crude oil, could be fatal since oil greatly reduces the insulative qualities of their type of fur (Kooyman et al. 1977). A major oil spill could eliminate this species from the impacted area.

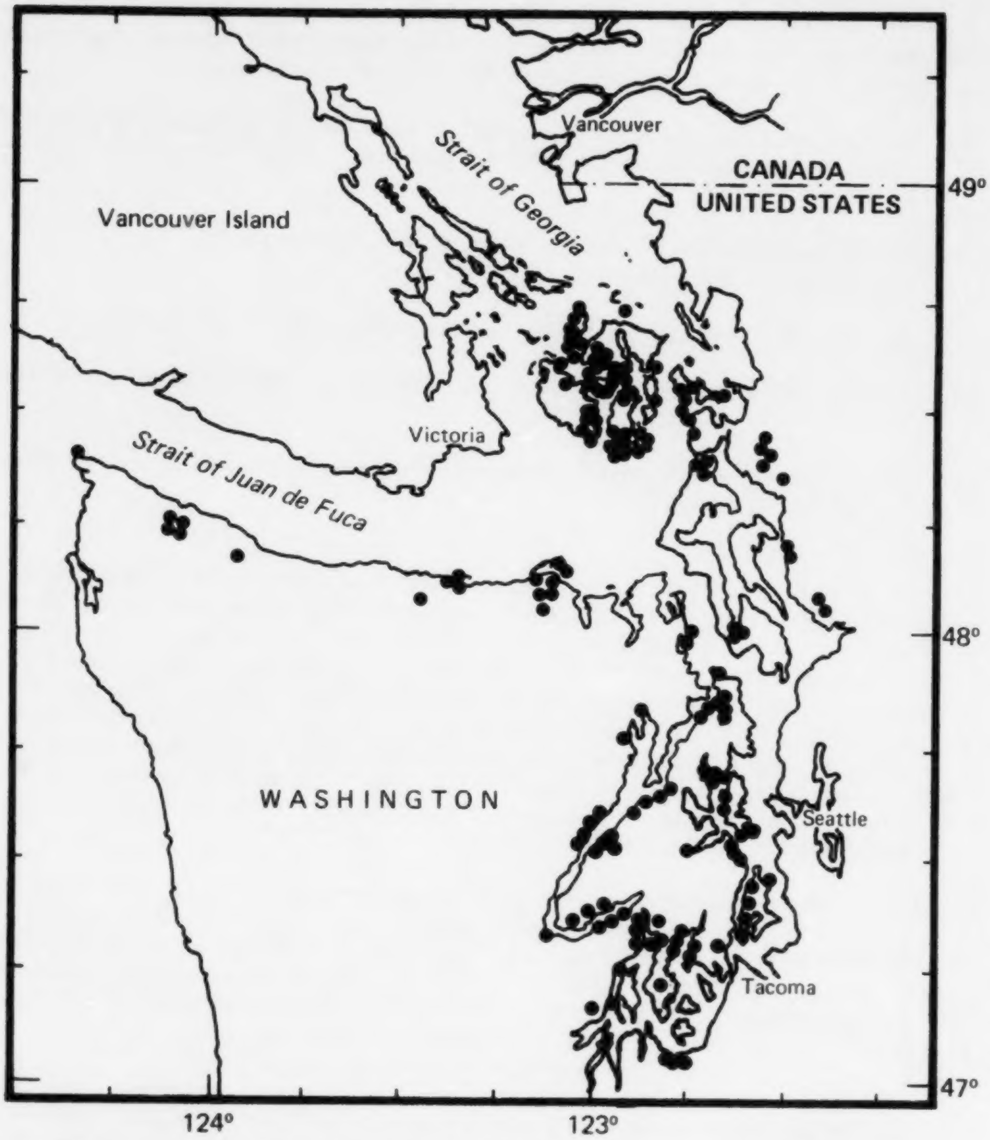

Vancouver
Strait of Georgia
CANADA
UNITED STATES
49°
Vancouver Island
Victoria
Strait of Juan de Fuca
48°
WASHINGTON
Seattle
Tacoma
47°
124°
123°

Figure 3. Locations where river otters (Lutra canadensis) were sighted or trapped in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca throughout the year (from Hirschi 1978 and this study).

California Sea Lion (Zalophus californianus californianus)

The California sea lion occurs in Washington waters from late fall to spring. Its range extends along the western coast of North America from the Sea of Cortez and Baja California, northward to Vancouver Island. It was first sighted in Washington on islets off the outer coast in 1950 (Kenyon and Scheffer 1962).

The southern California breeding season population numbered about 2,000 animals in 1940 (Bartholomew 1967); the numbers of animals in Mexican waters was larger although we have no estimates of its size at that time. The population has rapidly increased since 1940 and present estimates range from 75 to 125,000 animals (Le Boeuf et al. 1976; Mate 1977). During the late spring and summer breeding season most animals are found south of Point Conception, California. In early fall some animals (presumably all males) move northward, ranging north to southern British Columbia.

Adult male California sea lions can be recognized at all times by their prominent saggital crest which is light cream in color. The pelage of both sexes is brown to straw color. The haired portion of the foreflipper extends down to the first or second digit and the hind flippers are short compared to the fur seal. When hauled out this species is easily identiifed by its persistent barking.

California sea lion males attain a length of 2.2 m and may weigh as much as 275 kg; females are smaller, reaching a length of 1.8 m and a weight of 91 kg. This species is probably the most commonly displayed marine mammal in zoos and oceanariums (Cornell and Asper 1976).

Sea lions have been reported from 11 haul sites in Washington and adjacent waters (Everitt and Jeffries 1979). Study area haul sites are Sombrio Point and Race Rocks, Vancouver Island, British Columbia, Canada; Tatoosh Island, Sucia Island, and a beached barge in Port Gardner, Washington, although single animals have hauled out occasionally at other locations. In the study area, this species has been observed with northern sea lions, although at Port Gardner only a few northern sea lions have been observed. During the present study we found relatively few California sea lions at Sombrio Point compared to those observed here during the 1974-75 surveys (Everitt et al. 1979). Race Rocks is the most important hauling site and the only one used consistently from month to month (individual survey records are presented in Appendix Table A-1). The species occurs seasonally with peak abundance during the winter months, the first individuals are observed in October, peak numbers are seen from November to March declining in April and May, and they are essentially absent from June-September with few exceptions (Table 2). Low counts in February 1978-1979 were attributed to poor survey conditions. The exception to these general observations occurred in May 1979 when up to 108 individuals were observed at Port Gardner south of the study area.

California sea lions are most abundant and thus most vulnerable to environmental perturbations during winter. The locality most important to this species is the eastern Strait of Juan de Fuca. Since numbers here are low, adverse impacts to this seasonal local population of California sea lions would not affect its status over its entire range in the North Pacific Ocean.

Everitt et al. (1979) reported no hauling areas for California sea lions east of Race Rocks in 1978, thus the sighting of a large number of animals in Port Gardner in the spring of 1979 was of particular interest. First reports from private citizens in the Everett, Washington area indicated that a large group of unidentified seals had hauled out on a grounded barge just outside the Everett breakwater about 16 April 1979. These animals were identified by Everitt as California sea lions on 30 April. Six field trips were made to the haul site in May to count numbers present and to collect scat to use in identifying prey species being consumed (1, 3, 7, 12, 15, and 25 May). By 2 June the sea lions had left the Port Gardner area. The highest count (108 animals) was made on 3 May and probably was a minimum estimate since a few animals may have gone unobserved in the water. All animals that could be positively sexed were identified as males (Table 3).

Fish otoliths retrieved from scat and one spewing were sorted and sent to John Fitch (California Department of Fish and Game) for identification (Table 4). The predominant fish, comprising nearly 76% of all otoliths represented in these collections, was Pacific whiting (hake) (Merluccius productus). During May 1979 a small fishery for whiting, involving several boats, was under way in Port Susan. This whiting population may have been responsible for the animals' stay in the area.

Whiting have been reported as the major food item identified from Zalophus spewings collected at southeast Farallon Island, California in April and May, at the time when whiting are beginning to appear on the Continental Shelf in that area (Ainley et al. 1977). Whiting also appeared most often in California sea lion scat collected at San Miguel Island, California which is the northernmost major pupping and breeding island of this species (Antonelis and Fiscus 1980).

We inferred that California sea lions might occur singly or in small groups throughout the inland waters of Washington (Everitt et al. 1979) but the large group of animals which appeared in Port Gardner in the spring of 1979 represents a change in sea lion distribution and perhaps a response to a local abundance of prey. Large numbers of California sea lions may well occur annually in Port Gardner in future years.

TABLE 2.--Number of California sea lions (Zalophus californianus californianus) observed hauled out at all sites in the inland waters of Washington, by month, November 1977 to December 1979. Numbers observed include both positive and tentative identifications. Dashed lines indicate no survey made.

Date	Number observed 1977	1978	1979	Date	Number observed 1977	1978	1979
January	--	29	62	July	--	0	0
February	--	5	15	August	--	0	0
March	--	51	47	September	--	0	0
April	--	40	24	October	--	2	25
May	--	15	108[1]	November	--	0	296
June	--	0	0	December	76	65	144

[1] From land observations at Port Gardner, Washington.

TABLE 3.--Observations of California sea lions (Zalophus californianus californianus) at Port Gardner, Washington, May 1979.

Age class	Date 3 May 79	12 May 79
Adult males	49 (50.5%)	25 (31.3%)
Subadult males	26 (26.9%)	27 (33.7%)
Juvenile males	11 (11.3%)	4 (5.0%)
Unid. sex	11 (11.3%)	24 (30.0%)
Total (% identified males)	97 (88.7%)	80 (70.0%)

TABLE 4.--Otoliths of fish recovered from scats and a spewing of California sea lions (*Zalophus californianus californianus*) in Port Gardner, Washington, May 1979.

Prey species	Scat[1/] (n=8)	Spewing (n=1)	Total otoliths No.	Total otoliths (%)
Pacific whiting (*Merluccius productus*)	9	13	22	(75.9)
Walleye pollock (*Theragra chalcogramma*)	1	2	3	(10.3)
Pacific cod (*Gadus macrocephalus*)	1		1	(3.4)
English sole (*Parophrys vetulus*)	1		1	(3.4)
Unidentifiable	2	—	2	(6.9)
Total	14	15	29	

[1/] 47 scat were collected and 8 of these contained otoliths.

Northern Sea Lion (*Eumetopias jubatus*)

The northern (Steller) sea lion ranges from the Bering Sea to southern California (Rice 1977). Adult males attain a length of 3.2 m and can weigh up to 1,000 kg. Females are smaller, measuring 2.2 m and weighing 272 kg.

Northern sea lions are the largest of the Otariids. When hauled out with California sea lions they appear to be much larger and dorsally much lighter in color. This species does not have the knob-like protuberance (saggital crest) as do adult male California sea lions. In the water this species may appear almost white in color. Breeding occurs throughout its range from mid-May to mid-July. The breeding rookeries nearest to Washington are located at the Scott Islands north of Vancouver Island, British Columbia and to the south in Oregon; no breeding has been documented in Washington waters. Coastal islands where such breeding might occur are either not suitable or subject to washing in stormy weather. The current population status of the northern sea lion is presently in doubt. Kenyon and Rice (1961) estimated the world population of this species, based on surveys and literature to 1960, to be 240,000-300,000 animals. Recently, Braham et al. (1980) demonstrated a significant (50%) decline in population in the eastern Aleutian Islands; however, the population status in other areas has yet to be documented but probably will not show declines of this magnitude. The population off the California coast has experienced a decline from earlier published accounts and now numbers about 2,200 animals (Antonelis and Fiscus 1980). Pearson and Verts (1970) estimated the Oregon population at about 1,000 and Mate (1975) revised this figure upward to 2,000. Kenyon and Scheffer (1962) reported the results of aerial surveys along the Washington outer coast and north coast of the Olympic Peninsula. They stated that the Washington population of northern sea lions did not exceed 500 animals. Pike and Maxwell (1958) reported 11,000-12,000 northern sea lions in British Columbia with the southernmost breeding rookeries located in the Scott Islands (north end Vancouver Island). A concentrated effort to reduce this population was conducted in the 1960's and the most recent estimate was about 4,000 during the breeding season (Pike and MacAskie 1969). These animals congregate at a few breeding rookeries in the summer and spread out along the coast of British Columbia in the winter. Smith (1972) estimated that over 1,900 Eumetopias winter off the west coast of Vancouver Island.

At least 10 haul out sites are known for northern sea lions in Washington and adjacent waters, and four of these occur in the study area. Two of these sites are along the southern coast of Vancouver Island, where animals haul out in large numbers at Race Rocks and Sombrio Point (Smith 1972; Bigg 1973a). This species was first reported utilizing rocks on the northern side of Sucia Island on 15 December 1971 (M. Petterson pers. commun. to C.H. Fiscus, 1972). During the present surveys we observed northern sea lions at the Sucia Island haul site in November and December 1977 and January and October 1978; no animals were observed here during the 1979 surveys. Occasionally a few animals are seen hauled out on Tatoosh Island (Kenyon and Scheffer 1962; and present study). Jeffries (pers. commun.) observed 55 northern sea lions at Tatoosh Island on 22 October 1976.

Smith (1972) reported no more than 160 northern sea lions at Race Rocks and Sombrio Point in November of 1970. During aerial and land surveys for California sea lions in the inland waters, Bigg (1973a) also reported the occurrence of northern sea lions, reporting peak numbers at Race Rocks during December.

Although single animals can occasionally be seen in the protected waters of Washington at any time of the year, during the present study northern sea lions first appeared in early fall (September) and were present in greatest numbers from late fall to early spring (October to April) and absent during the summer months (June, July, and August) (Table 5).

TABLE 5.--Number of northern sea lions (Eumetopias jubatus) observed hauled out at all sites in the inland waters of Washington, by month, November 1977 to September 1979. Dashed lines indicate no survey made.

Date	Number observed 1977	1978	1979	Date	Number observed 1977	1978	1979
January	--	196	133	July	--	0	0
February	--	155	134	August	--	0	0
March	--	194	207	September	--	59	0
April	--	259	212	October	--	188	10
May	--	11	66	November	29	--	100
June	--	0	0	December	197	150	152

A small number of northern sea lions are present along the Washington coast during the summer months (Everitt and Jeffries 1979). The age-sex composition of this species in Washington is unknown but animals are presumed to be nonbreeding males and females. The coastal population undergoes a seasonal cycle similar to that described for the inland waters with a notable exception; maximum numbers on the coast of about 500 animals occur in the fall (September - December) and then drop slightly during the winter months as a result perhaps of a movement of animals to inside waters. Sea lion counts from inland waters were pooled with that from coastal haul sites, by month, and the highest monthly count during a 3-year period is used to demonstrate the seasonal cycle (Fig. 4) which is similar to that described for the inland waters. The highest count made for our study area was of 259 animals in April 1978.

Observations of northern sea lions in the water throughout the study area were made regularly during winter and spring months. Animals were observed in the water near Tatoosh Island on five occasions, although we saw them hauled out there only twice (Table 6). Middle Channel (near Cattle Point, San Juan Island) was another location where this species was regularly observed. The possibility that animals observed in the water may later be counted on land and included in total estimates cannot be discounted. The data in Table 6 are not included in total population estimates for this species. Animals were observed in the water through April but not again until September, coinciding with the decreased abundance of this species in the study area during late spring and summer.

We have little information on the feeding habits of northern sea lions in the study area. In other localities they consume a variety of the smaller flatfishes, whiting, walleye pollock, herring, salmonids, and squid (Spaulding 1964; Fiscus and Baines 1966).

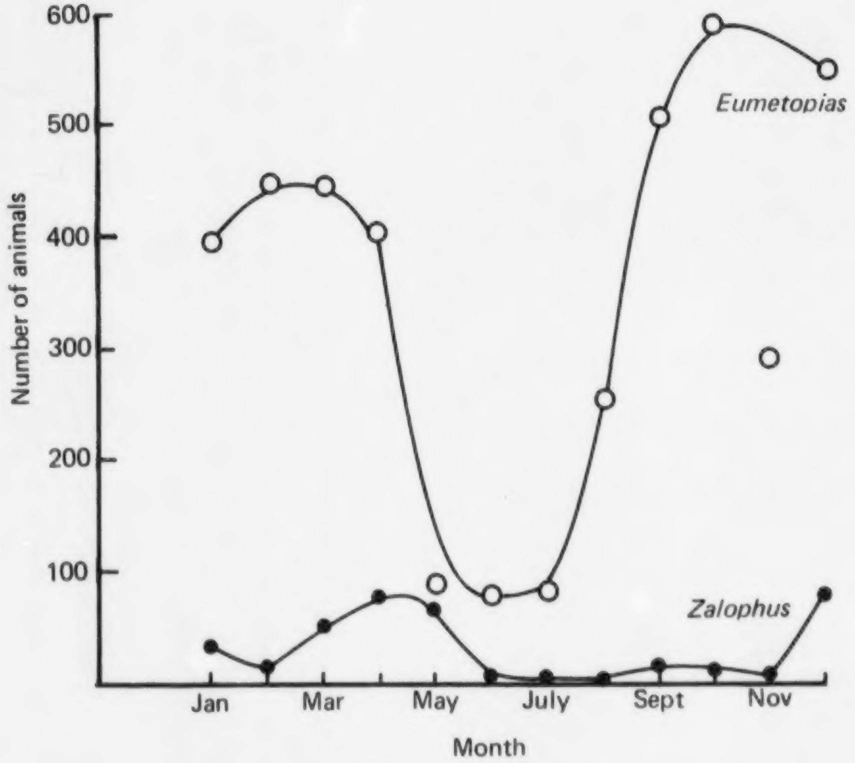


Figure 4. Monthly high counts of northern sea lions (Eumetopias jubatus) and California sea lions (Zalophus c. californianus observed in Washington 1976-1978.

TABLE 6.--Observations of northern sea lions (Eumetopias jubatus) in the water in northern Puget Sound, the San Juan Islands, and the Strait of Juan de Fuca from November 1977 to December 1979.

Date Mo./Day/Yr.	Number observed	Location
11/30/77	10	Patos I.
12/21/77	10	Waadah I.
1/28/78	9	Tatoosh I.
3/15/78	4	Whale Rks.
4/25/78	1	Mummy Rks.
4/25/78	9	Whale Rks.
4/25/78	3	Trial I.
4/25/78	1	Dungeness Spit
4/28/78	8	Tatoosh I.
9/12/78	1*	Tatoosh I.
9/12/78	8	Tatoosh I.
10/03/78	6*	Tatoosh I.
12/28/78	8	Tatoosh I.
1/18/79	1	Pysht River
4/26/79	1	San Juan Channel
5/22/79	1	Dungeness Spit
5/22/79	1	Kayak Point
12/05/79	20	Tatoosh I.

* hauled out

Northern sea lions are most abundant and thus most susceptible to environmental perturbations during the winter months when they are most abundant at Race Rocks in the eastern Strait of Juan de Fuca (Appendix Table A-2). Numbers of this species are low in the study area relative to other parts of its range; thus, adverse impacts to this local population would not seriously impact the breeding stock along the west coast.

Northern Fur Seal (Callorhinus ursinus)

The northern fur seal has been commercially exploited for many years and as a result, a great deal of research has been directed towards the conservation of this species. An international treaty between four nations, the United States, Canada, USSR, and Japan, calls for cooperative research and managed harvests of this species.

Like other otariids, northern fur seals are sexually dimorphic with males in prime condition measuring 2.5 m and weighing 140-280 kg, whereas females measure 1.7 m and weigh 30-50 kg. Fur seals will probably never haul out in the study area. In the water they can be separated from the sea lions because they are usually solitary and much smaller, dark (black) in color with white or gray about the throat which is visible when they rear up out of the water to observe approaching boats. Their hind flippers are about twice the length of those of sea lions relative to body size and the hair (fur) line of the foreflipper stops abruptly at the wrist. Most of the population of northern fur seals is found on the breeding grounds from mid-June through early November. Rookeries are found at San Miguel Island, California, the Pribilof and Commander Islands in the Bering Sea, and the Kuril and Robben Islands in the Okhotsk Sea (Rice 1977). In other months, fur seals maintain a pelagic existence in the subarctic waters of the North Pacific with concentrations along the continental shelf in areas of abundant feed from the Bering Sea and south to about lat. 32°N in the east and lat. 36°N in the west. Adult males remain in the northern portions of the range. Females and immatures occupy all areas of the range. The present estimate of the northern fur seal population is approximately 1.7 million and this population is distributed among the breeding islands as follows (NMFS 1980):

Pribilof Islands	1,250,000
Commander Islands	265,000
Robben Islands	165,000
Kuril Islands	55,000
San Miguel Island	2,000

Pelagic sealing, which was most detrimental since pregnant females formed a major portion of the catch, was banned in 1911 although a provision of the treaty allowed aboriginal hunting by traditional means (spears, harpoons, and from non-motorized craft). An estimated 50,000 fur seals were taken by British Columbia Indians from 1912-1940, of which approximately 85% of the annual take was from the west coast of Vancouver Island (Pike and MacAskie 1969). During a 29-year period from 1913 to 1941, over 12,000 fur seals were taken by subsistence Indian hunters in Washington waters, of which 58% were females (Table 7). These animals were taken from January through June, primarily from canoes out of Neah Bay, Washington. The take averaged 436 fur seals per year; however, in the latter years of the hunt the catch declined as fewer hunters put to sea each year. Most of the seals were taken in coastal waters from Umatilla Reef to the Strait of Juan de Fuca and usually 5 to 20 miles offshore.

As a part of the U. S. obligations under the Interim Convention on Conservation of North Pacific Fur Seals, biologists from NMML and its predecessor agencies periodically carried out ocean research off the coast of Washington. As the Makahs Indians had found out before them, they had

TABLE 7.--Yearly take of northern fur seals (Callorhinus ursinus) by Indians in Washington waters from 1913 to 1941. Dashed lines (-) indicate missing data.

Year	Male	Female	Total take
1913	1	90	91
1914	2	12	14
1915	-	-	-
1916	66	313	379
1917	209	304	513
1918	251	142	393
1919	251	303	554
1920	656	630	1,286
1921	-	-	567
1922	641	462	1,103
1923	271	569	840
1924	606	423	1,029
1925	823	883	1,706
1926	291	715	1,006
1927	95	178	273
1928	252	456	799
1929	166	421	587
1930	131	319	450
1931	24	141	165
1932	26	47	73
1933	23	18	41
1934	6	17	23
1935	10	70	80
1936	2	26	28
1937	10	35	45
1938	4	88	92
1939	-	-	30
1940	2	26	28
1941	1	20	21
Total	4,820	6,708	12,216

Source: Alaska Fisheries and Fur Seal Industries, Bureau of Fisheries, Department of Commerce 1913-1919. Alaska Fishery and Fur Seal Industries, Bureau of Fisheries, Department of Commerce 1920-1938. Alaska Fishery and Fur Seal Industries, Bureau of Fisheries, Department of Interior 1939-1941. Annual reports.

to go out seaward towards the edge of the Continental Shelf before they encountered many fur seals. Seals are seasonally abundant in Washington's offshore waters, making their first appearance in mid-November on their southward migration and their last in June while northbound. From December through May, the largest numbers of seals pass through these waters. There are almost always a few seals present offshore, and when migratory waves pass through they are abundant for the several days it takes to pass through Washington waters. Off the Washington coast the principal food of fur seals includes: herring, squids, salmon, rockfish, anchovy, smelt, capelin, lanternfish, and sauries. Many of these food species are also found in the protected waters of Washington and would be consumed here also.

During the years of offshore studies, research vessels regularly transited the Strait of Juan de Fuca and often visited Neah Bay. Three animals were sighted and two of them collected in March 1961, 11 miles northeast of Slip Point (lat. 48°20'; long. 124°10') (Fiscus et al. 1961). In 1958, two tagged yearlings were found in Puget Sound, one in February and one in March. In 1959, a tagged yearling was found near Neah Bay. A recent observation was made of a single animal in Haro Strait on 26 January 1978 (R.W. Osborne pers. commun.; Everitt et al. 1979). A few seals, mostly yearlings, venture into the Strait of Juan de Fuca and Puget Sound waters every year with most sightings occurring from January through March.

Harbor Seal (Phoca vitulina richardsi)

The Pacific harbor seal is the most abundant marine mammal found in Washington waters (Scheffer and Slipp 1944) and the only breeding pinniped in the state. Harbor seals are fairly easy to locate, count, and observe since they tend to haul out for resting and breeding purposes at nearly the same locations each year, unless that particular habitat is destroyed. This tendency to utilize traditional sites makes harbor seals ideal for use as an indicator species for determining effects of short and long term environmental disturbances in local areas at minimal cost.

The harbor seal occurs in the eastern North Pacific Ocean from the Bering Sea to Baja California and is considered abundant in most areas of its range (NMFS 1980). Harbor seals measure 1.25 m to 1.88 m in body length and weigh up to 110 kg. Pelage varies in color from almost entirely black to nearly white. Three color patterns occur in the pelage of harbor seals in Pacific Northwest waters: "black"--black or very dark brown dorsally and ventrally; "common"--the most abundant form in our waters is bluish gray to brown dorsally shading to white ventrally, spots on flanks are bluish gray or brown depending on whether pelage is new or old; and "muddy"--pelage is mottled with indistinct patterns, dark dorsally shading to lighter gray on flanks (Stutz 1967a).

During the present study more new information was collected on harbor seals than on any other marine mammal in the study area. A detailed discussion of this species follows.

Feeding habits: Use of fish otoliths as an aid to identifying prey species has been used for many years. Fitch and Brownell (1968) discussed using otoliths to describe and identify prey species found in the stomachs of cetaceans. Identification and use of otoliths found in harbor seal scats to describe prey species was first attempted locally in an undergraduate study at Oregon State University, Corvallis, Oregon (Drager 1977). An intensive treatment of this technique was applied recently in Puget Sound by a research group from The Evergreen State College, Olympia, Washington (Calambokidis et al. 1978). During the present study scats were collected opportunistically at Protection Island. Identification of otoliths recovered from these scats was made by John Fitch (Calif. Dep. Fish Game) and all identified prey species are listed in Table 8.

Scat were collected on haul sites on a 'not to disturb' basis and thus we had little control over the size of samples collected during each season. Few scats were collected in spring (March-May) and summer (June-August); most (77%) were obtained in the fall (September-November). Small sample sizes (in the spring and summer) made detailed comparisons among seasons difficult. For example, the three dominant prey items for all seasons--pollock (Theragra chalcogramma), English sole (Parophrys vetulus), and Pacific cod (Gadus macrocephalus), probably reflect the larger fall sample. A few interesting differences among seasons do warrant mention. The families Gadidae (cod) and Pleuronectidae (right-eyed flounders-sole) comprise 82.5% of all recovered otoliths (Table 9). In spring, pleuronectids are by far the dominant fishes present, representing 92.5% of all otoliths for that season. This group of fishes are well represented in summer (18.2%) and fall (36%) but to a lesser degree than in the spring. Cross et al. (1978) reported that many of the pleuronectids they sampled in sites throughout northern Puget Sound and the Strait of Juan de Fuca appeared regularly in all sample periods suggesting uniformity of abundance throughout the year and as such pleuronectids may represent important prey for harbor seals throughout the year. However, seals appear to switch prey preferences as seasonally abundant fishes move into the area.

During the summer, herring (Clupea harengus pallasi) otoliths are predominant in scat collections, comprising 54.6% of all otoliths recovered in that season. A substantial adult herring population congregates near Protection Island (in the channel between the island and the mainland) in January and February, and this area is an important nursery site for juvenile and immature herring in the spring and summer (Lemberg 1978). In fall, 47% of the otoliths are from gadids, a seasonally abundant group that appeared in trawl samples from Beckett Point (south of Protection Island) most often in fall and winter (Cross et al. 1978).

A run of pink salmon (Oncorhynchus gorbuscha) appears in central Puget Sound in the fall and was encountered during sampling of nearshore fishes at Beckett Point and Jamestown (Cross et al. 1978). During the fall, otoliths of this species appeared in limited numbers representing 1.6% of all otoliths

TABLE 8.--Species of fish identified from otoliths recovered from harbor seal scat collected on Protection Island, Washington, 1978-1979.

Species	All Seasons (115 scat)		Spring (12 scat)		Summer1/ (14 scat)		Fall2/ (89 scat)	
	No.	%	No.	%	No.	%	No.	%
Walleye pollock (*Theragra chalcogramma*)	128	(30.3)	1	(3.7)	3	(27.3)	124	(32.2)
English sole (*Parophrys vetulus*)	114	(27.0)	10	(37.0)			104	(27.0)
Pacific cod (*Gadus macrocephalus*)	39	(9.2)					39	(10.1)
Rex sole (*Glyptocephalus zachirus*)	22	(5.2)	10	(37.0)	1	(9.1)	11	(2.9)
Pacific herring (*Clupea harengus pallasi*)	21	(5.0)			6	(54.6)	15	(3.9)
Pacific tomcod (*Microgadus proximus*	19	(4.5)	1	(3.7)			18	(4.7)
Rockfish (*Sebastes* spp.)	18	(4.3)	1	(3.7)			17	(4.4)
Dover sole (*Microstomus pacificus*)	14	(3.3)	1	(3.7)			13	(3.4)
Petrale sole (*Eopsetta jordani*)	9	(2.1)	2	(7.4)			7	(1.8)
Pacific sanddab (*Citharichthys sordidus*)	9	(2.1)					9	(2.3)
Staghorn sculpin (*Leptocottus armatus*)	8	(1.9)					8	(2.1)
Pink salmon (*Oncorhynchus gorbuscha*)	6	(1.4)					6	(1.6)
Sculpin (*Enophrys* spp.)	3	(0.7)					3	(0.8)
Arrowtooth flounder (*Atheresthes stomias*)	2	(0.5)			1	(9.1)	1	(0.3)
Speckled sanddab (*Citharichthys stigmaeus*)	2	(0.5)	1	(3.7)			1	(0.3)
Sculpin (*Myoxocephalus* spp.)	2	(0.5)					2	(0.5)
Shiner perch (*Cymatogaster aggregata*)	2	(0.5)					2	(0.5)
Sablefish (*Anoplopoma fimbria*)	2	(0.5)					2	(0.5)
Sand sole (*Psettichthys melanostictus*)	1	(0.2)					1	(0.3)
Flathead sole (*Hippoglossoides elassodon*)	1	(0.2)					1	(0.3)
Lingcod (*Ophiodon elongatus*)	1	(0.2)					1	(0.3)
Total Otoliths	423		27		11		385	

1/ One scat contained a lower beak of an octopus (*Octopus* spp.)

2/ Two scats contained 4 squid beaks (*Loligo opalescens*) representing 3 individual squid.

TABLE 9.--Percentage of occurrence of important prey species reprsented in harbor seal scat collected at Protection Island, Washington, 1978-1979.

Prey item	All seasons	% Occurrence		
		Spring	Summer	Fall
Flounder-sole (Pleuronectidae)	38.5	92.5*	18.2	36.0
Cod-pollock (Gadidae)	44.0*	3.7	27.3	47.0
Herring (*Clupea harengus pallasi*)	5.0	0	54.6*	3.9
All others	12.5	3.7	0	13.1

*Dominant prey item

collected for that season. In consuming larger prey, pinnipeds bring them to the surface and shake them apart before swallowing; often the head is not eaten. Thus, larger prey items, such as salmon, may be underrepresented in scat. This is the first record of the recovery of salmonid otoliths from harbor seal scat collected in Washington. Otoliths from silver salmon (O. *kitsutch*) have been recovered from seal scat collected in Oregon (Drager 1977).

The major prey items identified from scats in southern Puget Sound harbor seals were whiting (*Merluccius productus*) in the spring and summer, and temporal variations in its occurrence were demonstrated (Calambokidis et al. 1978). Whiting otoliths were also the most commonly occurring otoliths in scat from harbor seals at Gertrude Island during collections in the fall of 1979 (J. Skidmore pers. commun.). A pattern of opportunistic feeding on locally abundant prey by harbor seals seems apparent from these data.

Scheffer and Sperry (1931) made some of the first reports on the prey species found in stomachs from harbor seals in Washington. Of 100 stomachs examined, over 90% of the contents were fishes, including Pacific tomcod, flounder, herring, sculpin, whiting, cod, pollock, and perch. Squid and octopus comprised less than 6%. Trace amounts of shrimp were also present. Only two of the stomachs with food held any salmon and 19 of the stomachs were empty.

Fisher (1952) reported on the feeding habits of harbor seals collected in British Columbia. Important prey items were rockfish, octopus, and herring. Salmon comprised the largest percentage of total volume of stomach contents. Fisher suggests that harbor seals are opportunistic feeders and prey most heavily on seasonally abundant species. Spalding (1964) compared the feeding habits of pinnipeds along the coast of British Columbia and found a preference for prey items similar to those found by Fisher. Spalding, sampling throughout the year, found eulachon to be the most important prey item in the winter. Herring and rockfish comprised most of the stomach volume in summer. Salmon was of major importance during the fall. Spalding estimated that the predation on salmon by harbor seals was insignificant when compared to the commercial catch.

Studies in other areas outside of Washington show major food items to include pollock, herring, cottids, mackerel, and molluscs (Imler and Sarber 1947; Wilke 1957; Kenyon 1965; Pitcher 1977; Pitcher and Calkins 1977). Size of prey taken increases with increasing size of the harbor seal (Spalding 1964).

Many of the studies discussed have shown herring to comprise a major component of the diet of harbor seals in most areas. Lemberg (1978) reported herring to be particularly abundant in some areas of the eastern strait during summer, fall, and winter months. One might assume that herring would be important to local harbor seals (particularly newly weaned pups) during this time and that loss of this food resource due to large-scale environmental perturbations may adversely impact survival of local harbor seals.

Reproduction: In the eastern North Pacific Ocean, harbor seal pupping occurs progressively later southward from Alaska to Puget Sound (May-June to August-September) and earlier from the Washington coast to the southern extent of the range (May to March) (Bigg 1969a). Scheffer and Slipp (1944) established that on the outer coast pupping begins in May and suggested that this season may begin one or two months later in Puget Sound. Newby (1973b) described three distinct pupping periods in Washington waters. His conclusions, based on personal observations, interviews, and the literature, put the coastal pupping season as occurring during May, in northern Puget Sound from late July through August, and in southern Puget Sound from mid-August to late September. The period for southern Puget Sound, which was based on the Gertrude Island population, was later confirmed by Johnson and Jeffries (1977).

Calambokidis et al. (1978) reported similar pupping periods for Puget Sound and in Hood Canal. They first observed pups in early August in Hood Canal and southern Puget Sound, observing newly born pups on the Skokomish Delta in Hood Canal from August until the end of the study period in November 1978. The reason for the protracted pupping season on the Skokomish Delta is not known.

Bigg (1973b) suggested that the range of pupping periods for harbor seals may be in response to seasonal variations in food resources, and that local populations may have evolved in response to these differences. Bigg and Fisher (1975) demonstrated that photoperiod may be a proximate factor that stimulates estrous and thus reproductive timing in harbor seals, based on studies of captive animals from two different populations that pupped at different seasons.

During the present study all haul sites were examined for pups. Pups were first observed during the last week of June in 1978 and 1979 at Minor Island. The peak of pupping in the study area was observed in August when 143 pups were counted in 1978 and 240 in 1979. The pupping season lasted about 11 weeks with the last obvious pups seen in mid-September. Regular surveys were made along the coastline in the western Strait of Juan de Fuca but few pups were observed there. Pups were observed on 55 sites (Table 10), and of these, 27 sites are on wildlife refuges, either in the San Juan Wilderness areas or Dungeness Wildlife Refuge. These refuges are administrated by the Nisqually Wildlife System, U.S. Fish and Wildlife Service, Olympia, Washington, and public access is restricted. The most important pupping area in northern Puget Sound is on Minor Island, which is a part of the refuge system. On 27 July 1978 44 pups were counted (the season high) at Minor Island, which represented 30.8% of all pups observed in the study area that year. The entire refuge system, including Minor Island, accounted for 35% of the maximum pup counts for the study area in 1978. These protected pupping sites will be important sanctuaries for the harbor seal population as recreational use of land and waterways in the study area increases.

Table 10 lists the percentage pups comprised of all seals sighted for each hauling site. Certainly some pups went unobserved or may have been mistaken as immatures and included in the total count of each locality. The difficulty of counting pups from the air can be seen by comparing ground counts taken at Protection Island with aerial estimates. Three surveys were flown around the island in early August when pups were present. During surveys flown on 6, 7, and 8 August, 10, 4, and 9 pups, respectively, were counted. An observer on the ground counted 20, 15, and 19, pups respectively. Thus the aerial surveys produced counts of less than half those of the ground observers. Eberhardt et al. (1979) discuss the problems of estimating total pup productivity from aerial surveys and include such uncontrollable obstacles as pups obscured by rocks, bushes, and adults. Reliable estimates of pup production may only be obtainable with use of an extensive tagging program (Summers and Mountfield 1975). Therefore, an estimate of productivity based on visual observation is conservative. An average reproductive rate of 19.8% was found in the study area which is low when compared to that of other localities. Venables and Venables (1955) reported a 22% reproductive rate for *Phoca vitulina vitulina* in the Shetland and Orkney Islands. Bishop (1967) reported that 32% of the harbor seals on Tudigak Island, Gulf of Alaska, bore pups. Bigg (1969b), working with *Phoca v. richardsi* in British Columbia, and Boulva (1975) with *Phoca v. vitulina* at Sable Island, Nova Scotia, report similar reproductive rates

TABLE 10.--Harbor seal pupping areas in northern Puget Sound and the Strait of Juan de Fuca, 1978-79. The percentage of pups represented in the total count for each haul out site is given, as is the maximum count for each site obtained during the two year survey period. Dashed lines (-) indicate the site was not surveyed; (*) indicates no pups were observed.

Reference	Location	% Pups[1] 1978	% Pups[1] 1979	Maximum pup count
	San Juan Wilderness Area[2]			
9	Unnamed Island	.22	*	2
21	Mummy Rock	*	.06	1
24	Harbor Rock	.50	*	1
26	Halftide Rock	.06	.33	8
32	Sentinel Rock	.12	.09	6
35	Ripple Island	.06	.25	5
37	L. Cactus Island	.15	.20	3
40	White Rock	*	.10	2
42	Skipjack Island	.09	.06	5
43	Unnamed Island	.07	*	2
49	Unnamed Islet	.25	*	1
50	Tift Rocks	.14	.24	5
54	Flower Island	.10	*	1
57	Pointer Island	.29	*	2
62	S. Peapod Rock	.06	*	1
63	Peapod Rocks	.07	.06	4
64	N. Peapod Rock	.25	*	1
65	Eliza Rock	.17	*	1
68	Unnamed Rock	*	.13	1
74	Unnamed Rocks	.12	.33	7
76	Minor Island	.21	.15	44
77	Matia Island	*	.05	1
78	Puffin Island	.05	.13	13
80	Bird Rocks	.07	.11	8
81	Williamson Rock	.50	.20	2
83	Buck Island	.08	.11	2
84	Bare Island	.08	.08	4
	Northern Puget Sound[3]			
C	Samish Bay	.12	.20	12
D	Padilla Bay	.10	.22	17
E	Hat Island	*	.25	1
G	Sinclair Island	.33	.50	2
H	Boulder Reef	.15	.10	4
I	Point Migley	.09	*	7
K	Barnes Island	.11	*	3

TABLE 10.--continued

Reference	Location	% Pups[1] 1978	% Pups[1] 1979	Maximum pup count
L	Echo Bay	.20	.37	13
M	Sentinel Island	1.00	*	1
O	Twin Rocks	.13	.15	4
R	Bell Island	1.00	*	1
S	Leo Reef	.11	.25	2
T	Pear Point	.13	*	2
V	Whale Rock	.13	*	2
W	Protection Island	.17	.17	29
X	Marrowstone Island	.09	*	1
-	Skagit Bay	-	.12	3
	Olympic Peninsula[3]			
2	Kulakala Point	.10	.80	4
3	Dungeness Refuge	.15	.45	27
4	Green Point	1.00	*	1
5	Low Point	*	.15	6
6	Deep Creek	*	.09	2
	Vancouver[3]			
10	Chain Island	.01	.10	18
11	Trial Island	*	.12	6
12	Race Rocks	.03	.17	28
13	Becher Bay	*	.12	6
17	Providence Cove	*	.04	6
-	Boundary Bay	-	.09	39

[1] Pup ratio for each haul site was derived by $\frac{\text{\# pups observed}}{\text{\# of adults + immatures}}$

[2] Map reference refer to Appendix Figure A-1

[3] Map reference refer to Appendix Figure A-2

of about 20.5%. Pitcher (1977) found a reproductive rate of 18.8% for harbor seals in the Copper River Delta, Alaska, and thought that Bishop's figure may be high due to sampling bias. Calambokidis et al. (1978) found that 15-19% of the animals sighted in northern Puget Sound in the summer of 1977 were pups. Thus, as reported by other investigators, birth rates can vary from 18-32%. It seems likely that the low rates and large variability observed in the present study may be attributable to difficulty in assessing this population parameter using only visual observations from aerial surveys.

Distribution: The harbor seal ranges in the eastern North Pacific Ocean from Baja, CA north and west to the Aleutian Islands and Bering Sea (Rice 1977). Harbor seals are most frequently found in estuaries and coastal and inland salt or brackish waters throughout its range. While primarily a nearshore species, observations of single animals have been reported up to 50 km from shore (Fiscus et al. 1977). During the present study, 55 haul sites were observed in northern Puget Sound, the San Juan Islands, the eastern bays, and the Strait of Juan de Fuca. The location of these sites is shown in Figure 5. Fifteen of these sites were observed in the Strait of Juan de Fuca; three in Admiralty Inlet, eight in Skagit, Padilla, Samish, Bellingham and Boundary Bays; and the remainder (29) in the San Juan Islands, adjacent to Haro and Rosario Straits. These 55 sites are used consistently by harbor seals. Occasionally animals would be observed in other areas but with no predictability. No new haul sites were found during small boat surveys and we did not survey in Canadian waters north of Victoria (except for one survey in Boundary Bay in August 1979). Aerial surveys in Canada, conducted by the National Marine Mammal Laboratory during 1974-75, identified a minimum of ten haul sites in the Strait of Georgia and one in Haro Strait that were not surveyed in the present study (Everitt et al. 1979).

For a haul site to be attractive to harbor seals, it must possess three characteristics: isolation from unseen approach by land, immediate access to deep water or channels, and nearness of food resources (Scheffer and Slipp 1944). Calambokidis et al. (1978) described five categories (substrate) of haul sites, of which four are present in this study area; cobble or sandy beaches, such as that of Violet Point, Protection Island; rocky reefs and island ledges exposed at low tides as occur at Puffin Island; mudflats exposed at low tides which are found at Dungeness Wildlife Refuge and all the bays in the area; and anchored log booms in Fidalgo Bay, Port Gamble, and Port Angeles. Examples of these habitat types are depicted in Everitt et al. (1979).

Population estimation: During the present study, aerial surveys were made on a monthly basis. All known haul and potential haul sites were surveyed. Counts of harbor seals obtained during these surveys of the study area from December 1978 through August 1979 are presented in Appendix A, Tables A2-7, by haul sites, which are shown in Appendix Figures A1-2. Observations from land and boat were made at Protection Island to

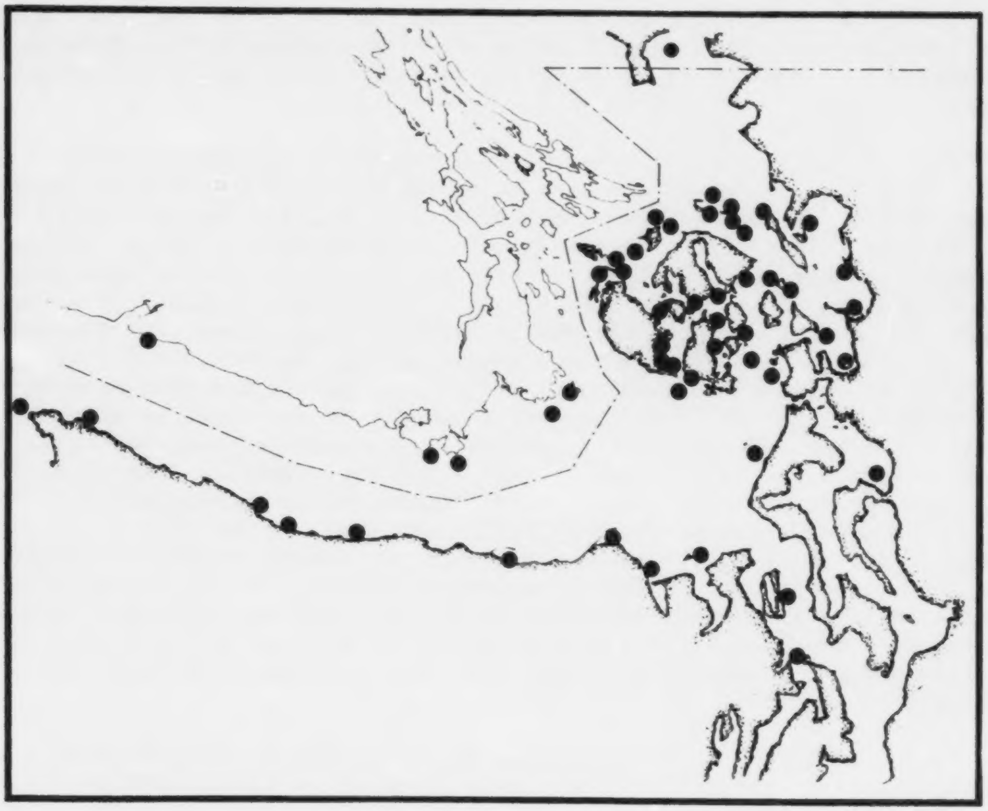


Figure 5. Locations of known haul sites of harbor seals (*Phoca vitulina richardsi*) in the study area.

determine the best time to survey when maximum numbers of harbor seals would be ashore. The importance of tidal influence on harbor seal hauling behavior has been reported often (Scheffer and Slipp 1944; Bishop 1967; Newby 1971; Johnson and Jeffries 1977; and Calambokidis et al. 1978). Most of these authorities report that harbor seals haul out on low tides, although local variations are known to exist. Calambokidis et al. (1978) demonstrated that high tide haul sites are used in Hood Canal and some nocturnal haul sites are used in southern Puget Sound regardless of the stage of the tide.

Preliminary surveys in the study area pointed to low tide haul outs and surveys were scheduled accordingly. Low and ebb tide hauling behavior has been reported for Skipjack Island in the San Juan Islands and at Minor Island (Calambokidis et al. 1978). A unique situation was documented on Protection Island where observations showed that the highest daily counts most often occur during the morning ebb tide with time of day also being an important consideration; animals appeared most likely to haul out from late morning to midday and least likely in the afternoon ($P>.05$) (Everitt, 1980).

Disturbance of the haul out site at Protection Island can be attributed to various sources, although man-caused disturbance is a major contributing factor in this tendency toward a morning haul out. Disturbance most often occurred in late morning-early afternoon through late afternoon, and was also most prevalent over the weekends (Saturday-Monday) when pleasure boating is greatest (Fig. 6). Continuous daytime observations were made on 42 of the 56 days from 14 June 1979 to 8 August 1979, and 99 disturbances were recorded for 83% of the sampled days, an average of 2.8 disturbances per day. Most disturbances (78%) were caused by pleasure boats approaching the haul site too closely, which resulted in the animals fleeing into the water (Table 11).

TABLE 11.--Type of disturbance resulting in harbor seals entering the water from the haul site at Protection Island, June-August 1979.

Source of disturbance	Number	Percent
Small boat	77	78
Aircraft		
airplane	12	12
helicopter	3	3
Human presence on beach	7	7
TOTAL	99	100

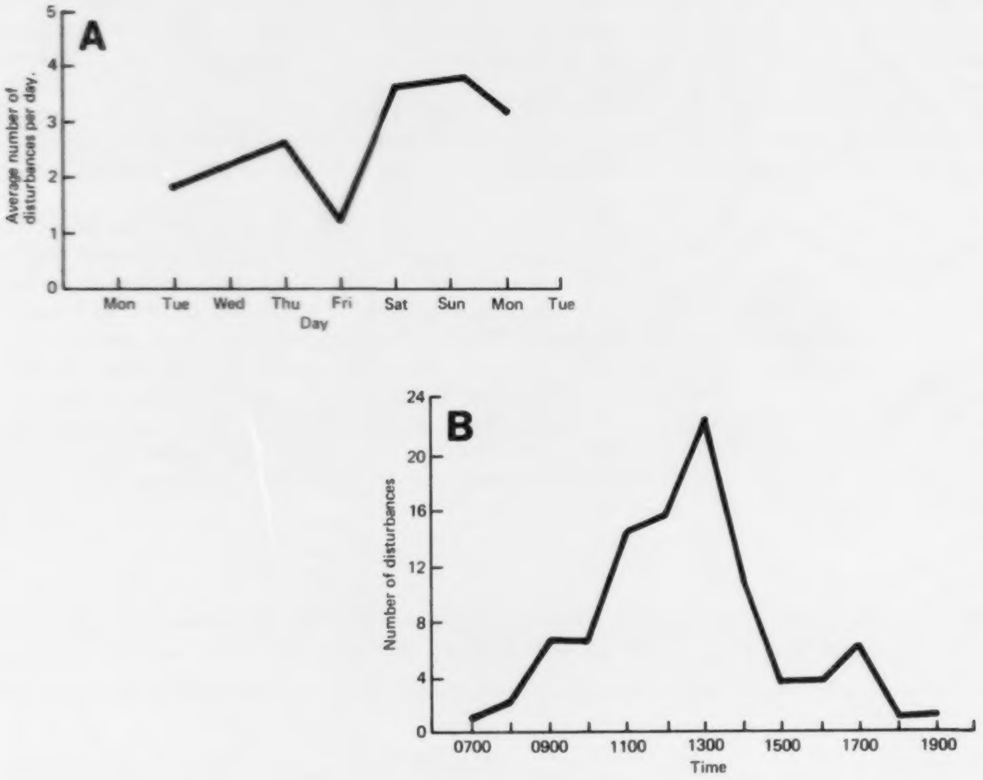


Figure 6. Observed disturbance of harbor seals at the Protection Island haulsite. June-August 1979 by (A) day of the week and (B) time of day.

One might expect more disturbance at Protection Island, which is undergoing development, than at other more isolated areas. However, disturbance caused by recreational boats has been observed in other areas (particularly the San Juan Islands) as well. The importance of planning surveys around morning low tides in northern Puget Sound to insure a greater probability of observing the maximum numbers of hauled out animals, preferably during mid-week, seems clear.

Estimates of abundance for P. v. richardsi are difficult to obtain. Population estimates for the North Pacific area are in excess of 300,000 animals (NMFS 1978), of which most can be found in Alaskan waters. Mate (1977) estimated 12,000 animals along the West Coast from Washington to Baja, California, Mexico from surveys that did not include Puget Sound.

Scheffer and Slipp (1944) estimated the Washington population of harbor seals at 6,000-10,000 animals. Newby (1973a) assumed the historical population was nearer to 6,000 and produced evidence of a possible decline to 2,000 animals, which he attributed primarily to bounty pressure and habitat loss. Between 1943 and 1960, over 10,000 harbor seals were taken for bounty in Washington, which is undoubtedly considerably less than the number actually killed (Newby 1973a). Assuming a 40% loss to unretrievable animals, the total kill may have actually exceeded 17,000 (Scheffer and Slipp 1944; and Newby 1973a). In a summary of 9,503 bounty records from Washington claimed between 1947 and 1960, 3,619 animals (38%) were killed in the northern Puget Sound area (Johnson and Jeffries 1977).

A minimum estimate of harbor seals in northern Puget Sound in 1972 was about 600 animals (Newby 1973a), and Johnson and Jeffries (1977) estimated 650 harbor seals in this region in 1975-76. In a more comprehensive census of this area in 1977, Calambokidis et al. (1979) reported at least 1,200 animals. Newby, Johnson and Jeffries, and Calambokidis et al. estimates were for approximately the same areas. The Canadian coast (Regions I-II), some areas in the San Juan Islands (Regions III-IV), the eastern bays (Region V), and the Strait of Juan de Fuca (Regions I-II), were not considered in any of these earlier estimates.

Our high count for the study area was taken in August 1979 when 2,179 harbor seals (including pups) were observed during aerial surveys; of this total, 1,623 were from U.S. haul sites and 556 from Canadian haul sites. To aid in the presentation of this data, the study area was divided into 17 sampling units (Fig. 2). Monthly counts of harbor seals are summarized by sampling unit in Table 12. If two surveys were made in the same month the larger count was used. The lower totals observed from November through January may be the result of the higher tides encountered during winter months which may have contributed to the low counts during these periods. From February through July, 1,000 animals were consistently observed, a count which may be comparable to the 1,200 reported by Calambokidis et al. (1978), and may represent the number of animals easily observable at any one time.

TABLE 12.--Maximum counts of harbor seals obtained during aerial surveys of the Strait of Juan de Fuca, Northern Puget Sound, the San Juan Islands and the eastern bays November 1977 to August 1979, summarized by sampling units. Dashed lines (-) indicate the area was not surveyed; (o) indicate no animals were sighted; location of local units shown in Figure 2. Pup counts are given in ( ) and are not included in the adult total.

Local Unit	December		January		February		March		April		May		June		July		August		September	October	November
	1977	1978	1978	1979	1978	1979	1978	1979	1978	1979	1978	1979	1978	1979	1978	1979	1978	1979	1978	1978	1977
1	0	-	-	0	-	-	0	0	-	-	-	0	0	0	-	-	-	0	0	-	-
2	86	2	86	103	25	-	114	73	93	101	150	313	46	270	128 (12)	267 (3)	245 (20)	248 (26)	229 (3)	279	1
3	49	12	90	134	103	-	178	123	256	127	126	182	42	208	52 (7)	174 (7)	102 (8)	189 (16)	69	118	17
4	58	15	29	15	14	-	0	95	60	122	140	207	243 (6)	168	247 (10)	44	355 (31)	157 (26)	188	348	0
5	40	1	43	26	41	-	54	84	57	35	44	81	66	172	65 (2)	81 (2)	197 (21)	168 (15)	122 (7)	122	0
6	12	1	23	2	1	-	15	51	39	72	12	24	27	153	35	-	119 (15)	146 (32)	169 (1)	35	0
7	164	47	165	109	257	-	116	187	74	216	25	40	162 (20)	118 (6)	196 (44)	151 (14)	206 (17)	194 (18)	2	155	50
8	-	-	-	-	-	-	0	0	-	0	0	0	-	-	0	-	10	24 (3)	0	-	-
9	24	4	6	26	10	0	21	16	9	0	8	22	14	16	3	-	20 (1)	26	31	49	-
10	183	102	134	157	155	181	164	153	149	147	87	73	71	178	113 (15)	126	113 (19)	133 (10)	128	223	100
11	0	64	81	0	90	5	90	96	81	35	35	107	41	24	45 (3)	16	54 (8)	88 (31)	8	66	0
12	0	0	0	0	0	-	0	0	0	0	0	0	1	0	2 (1)	-	2	-	2	3	0
13	1	0	8	5	18	21	9	16	7	6	1	5	2	10	2	-	47	63 (8)	37	3	51
14	0	0	0	0	0	-	0	5	0	7	0	0	0	2	0	-	0	2	0	0	0
15	0	0	0	0	0	-	0	0	0	0	0	0	0	0	0	-	3	0	0	0	0
16	0	0	0	0	35	-	0	17	20	0	0	0	2	8	9	-	0	50 (2)	6	42	-
17	26	57	120	171	242	63	243	264	230	192	335	227	190	269	210 (3)	-	145 (3)	446 (58)	83	144	-
Monthly total	643	305	785	748	991	270	1004	1180	1075	1060	963	1281	907 (26)	1623 (6)	1107 (97)	859 (26)	1618 (143)	1934 (245)	1074 (11)	1587	219

Johnson and Johnson (1979) have reported an increase in observable animals during the molting periods when supposed physiological stress forces more animals to haul out for longer periods. In local waters, the molt may occur from as early as February to as late as October (Scheffer and Slipp 1944; Stutz 1967b) although most of the population is involved in the molt from July to September (Stutz 1967b). At least one observer was present on Protection Island from 14 June through 27 September 1979. The mean weekly count of harbor seals increased significantly in September, and although it was difficult to accurately determine the stage of an animal's molt from the observation point, we felt that the greatest numbers of molting animals were hauling out in September. Mean weekly counts of harbor seals from June to early September were less than 150, increasing to over 200 by mid-September. The molting period coincides with our high area count in August 1978 of 1,761 harbor seals and in August 1979 of 2,179 harbor seals. The lower count in September 1978 is attributed to poor aerial survey conditions, primarily local fog during 12-14 September 1978. Foul weather also hindered complete coverage of the study area and thus lowered counts during December 1978 and February and July 1979. No surveys were flown in October and November 1979. The increase in numbers of seals from August 1978 to August 1979 cannot be attributed to an expanding population based on present data. Nearly all of this increase comes from the area bounded by Becher Bay and Discovery Island (Unit #17, Fig. 2) and was probably the result of better local conditions and/or reduced disturbance. Assessment of harbor seal population changes based solely on aerial counts has proved difficult elsewhere in Puget Sound (Calambokidis et al. 1979).

A description and narrative summary of each sampling unit (see Figure 2 for locations) is given in Appendix B.

Washington State Population: Recent counts of harbor seals (most from aerial surveys) have provided for the first time complete coverage of the state in a restricted time period. Johnson and Jeffries (1977) surveyed the outer coast from the Columbia River to Cape Flattery and provided counts from Gertrude Island (southern Puget Sound). Calambokidis et al. (1979) extensively surveyed the southern sound and Hood Canal. These efforts, together with the present study, provide a current minimum abundance estimate of over 7,000 harbor seals for the State of Washington based on counts which, due to the limitations of these types of surveys (discussed earlier), can be considered low (Table 13). Previous estimates of the Washington population were at least 5,000 in 1942 (Scheffer and Slipp 1944), 1,710 for 1965 to 1972 (Newby 1973a), and 5,500 in 1976 (Johnson and Jeffries 1977). The higher counts in Table 13 may indicate an expanding population although the magnitude of any increase cannot be assessed with these data. Certainly these higher counts reflect better survey coverage of the entire state than earlier investigators were able to accomplish.

Harbor seal tagging and marking experiment: Protection Island was selected as a location for an "on site" study of the harbor seal in 1978. Observations of daily and seasonal hauling behavior, timing of pupping and suckling, reproduction, feeding cycles, and collection of scats to identify prey species, and observations on molt were among the data recorded. These

Table 13.--High counts of harbor seals in Washington waters, 1975-79. Counts include pups.

Area	Count	Source
Columbia River	400	Johnson and Jeffries 1977
Grays Harbor-Willapa Bay	2,700	Johnson and Jeffries 1977
Outer coast	1,300	Johnson and Jeffries 1977
Strait of Juan de Fuca/ northern Puget Sound	1,623[1]	Present study
Hood Canal	732	Calambokidis et al. 1979
Southern Puget Sound	337	Johnson and Jeffries 1977, Calambokidis et al. 1979
Washington State Total	7,092	

[1] Does not include counts from hauling sites in Canadian waters.

observations were useful, enabling us to relate patterns seen here to observations throughout the entire northern Puget Sound-Strait of Juan de Fuca study areas.

A tagging and marking program was initiated in the spring of 1979 to determine the feasibility for an expanded project encompassing all of northern Puget Sound. One or more observers were stationed on Protection Island (from 15 June 1979 to 21 September 1979) to continue studies initiated in 1978 and collect data from tagged and marked animals. The objectives were to determine the extent of individual movement, describe individual site fidelity, and to verify hauling patterns. Attempts to capture were largely unsuccessful as the seals that haul out on Violet Point are extremely wary and enter the water at the slightest provocation. Five seals were captured using a gillnet (25 cm stretch mesh) without leadline so the seals could surface, set parallel to the shoreline at the haul site and about 50 m offshore. Only one seal, a young mature male, was outfitted with a radio tag as the attachment anklet could not be adapted to fit on smaller animals. All five animals were tagged with round post monel tags and marked with bright paint (Woolite Sheep Branding Dye) which was easily visible from the hillside observation station and from the air. The painted marks remained recognizable until the onset of molt in the fall of 1979.

All of the marked animals were resighted at least once after being tagged and marked (Fig. 7). The animal with attached radio was observed most frequently as the radio signal alerted the observer as soon as the seal hauled out and visual search was made immediately. During the period that the marked animals were being watched on Protection Island, six aerial surveys were flown over the island and adjacent haul sites. No marked animals were observed at any site other than the Protection Island site during the flights and marked seals were sighted during 4 of the 6 flights. These observations suggest that most of the Protection Island harbor seals remain in the vicinity during the summer breeding months.

Harbor seals are capable of moving considerable distances and if we wish to add to our present knowledge of this species in the study area, the next logical step will be to instrument 25 to 30 seals from major haul sites and set up a series of receivers throughout northern Puget Sound and the Strait of Juan de Fuca to monitor their movements.

Pitcher and Calkins (in press) conducted extensive radio telemetry studies with harbor seals in the western Gulf of Alaska. They located 8 tagged seals (a total of 35 were radio tagged) at hauling areas other than the site of capture. The longest movement was that of a mature female which was resighted 194 km from the capture site. The other seals (seven) traveled traveled from 24 km to 74 km from the original site. The rate of travel for these animals ranged from 19 km/day to 27 km/day. Reports of seal movements in southern Puget Sound suggest that both long distance movements and site fidelity can occur in the same local population (Calambokidis et al. 1978). These authors reviewed recent literature on this subject which indicates that long distance movements are not uncommon for Phoca vitulina. Everitt and Jeffries (1979) reported that a harbor seal radio tagged in Grays Harbor moved to the Columbia River and suggest such movements may be in response to seasonally abundant prey items.

Northern elephant seal (Mirounga angustirostris)

Northern elephant seals may reach a body length of 4.8 to 5 m, and in prime condition may average 1800 to 2300 kg; females are smaller, attaining a length of about 2.5 m and a weight of 900 kg and newly born pups are about 1 m long and weigh about 35 kg (DeLong 1978; NMFS 1979). Adult males are easily distinguished from females by their long proboscis which they are capable of inflating. In both sexes the pelage ranges in color from silver gray to light brown; pups are born with a black natal pelage but assume adult pelage after the first molt. Young elephant seals have been mistakenly identified as harbor seals on Washington beaches because at 6 to 9 months of age they are only slightly larger than adult harbor seals; however, the uniform pelage distinguishes them from the variously and contrastingly marked light and dark pelage of harbor seals.

Based on rather scant information, the northern elephant seal feeds primarily on benthic neritic and demersal prey and to a lesser degree on epipelagic and mesopelagic prey. Antonelis and Fiscus (1980) summarized

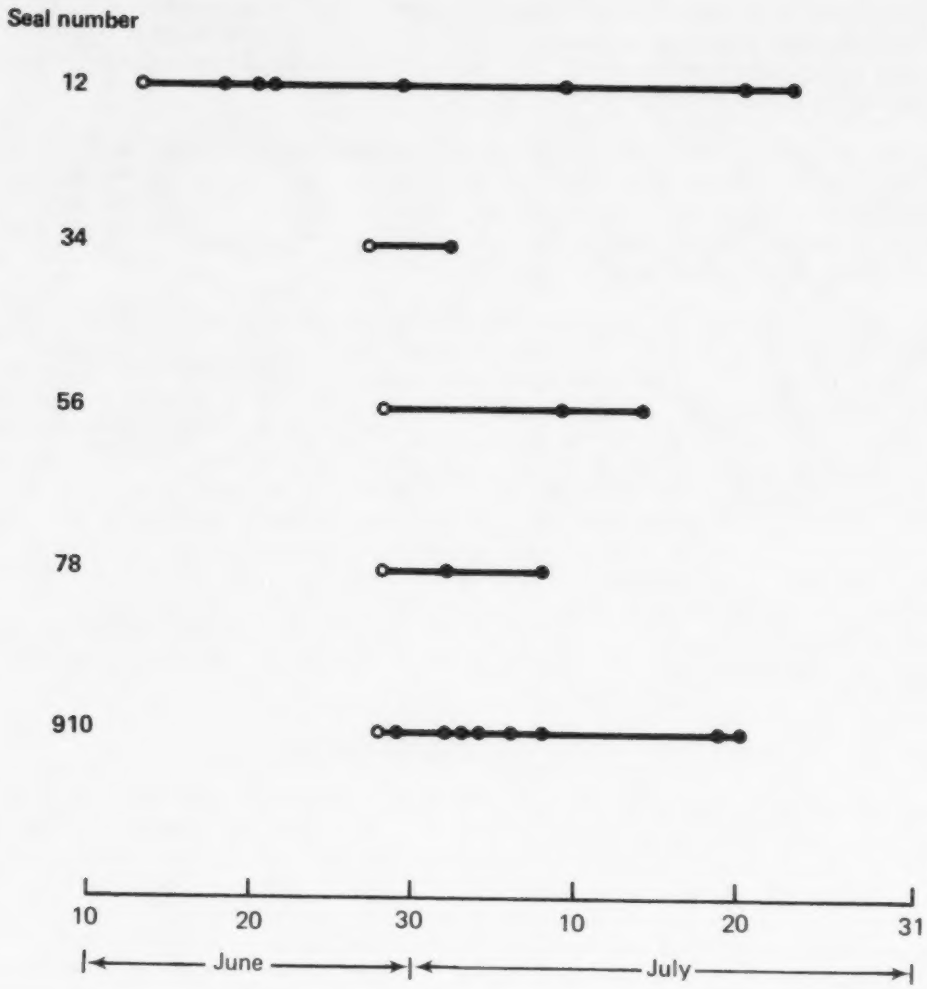


Figure 7. Dates harbor seals were marked and tagged at Protection Island, Washington in 1979 and later resighted. Date of capture, marking and tagging indicated (°) and resighting (•). Seal number 910 was also radio tagged.

what was known about the species of fish and cephalopods consumed by the northern elephant seal and list five cartilaginous fish, six bony fish, and nine cephalopods among its prey.

The population had reached a low of about 100 or fewer animals by 1890 as a result of exploitation by sealers and whalers for its oil. The population has since recovered and now numbers about 60,000 animals (Le Boeuf and Bonnell 1978). The species has reoccupied all its former breeding range which extends from Isla San Benito, Baja California, Mexico north to southeast Farallon Island, California. Some portion of the population ranges north in the eastern North Pacific Ocean into the Gulf of Alaska. Most observations of this species at sea away from its breeding locations are of solitary animals. In 1977 and 1978, three observations were made of this species in the eastern Aleutian Islands (Withrow and Everitt unpub. records) and in 1978 two animals were observed at Midway Island in the northwestern Hawaiian Islands (Antonelis and Fiscus 1980).

The northern elephant seal has been sighted in the inside waters of Washington in April, May, August, September, October, and December and from the offshore waters of Washington and British Columbia during all other months of the year except November (Everitt et al. 1979; Pike and MacAskie 1969, NMML records). We suspect that some animals may be seen in Washington waters during all months of the year.

The remains of elephant seals have been found in the middens at Cape Alava, Washington (Dr. Carl Gustafson pers. commun.); Cowan and Carl (1945) reported that the Makah Indians encountered them off the Strait of Juan de Fuca in the spring while hunting fur seals and took them on occasion during the latter part of the 19th century. Their numbers were so low during the first half of the 20th century that we have only a few records of the species from the northern part of its range and the first verified sighting of the species in Puget Sound was made on 20 April 1963 (Scheffer and Kenyon 1963). The second record from Puget Sound was that of Craddock (1969) on 2 September 1968. During the 1970's, elephant seals have been seen with increasing frequency in the study area.

Most elephant seals sighted in Washington waters have been identified as males, which were classified as yearlings, subadults and adults. Only two females have been positively identified, one a small molting tagged animal that came ashore in Discovery Bay on 10 April 1977 and remained for several days, and a dead female which beached at Murden Cove, Bainbridge Island on 24 January 1979 and was salvaged and placed in the collection of the University of Puget Sound, Tacoma, Washington (S. Jeffries pers. commun.). We have listed all elephant seal sighting records (37) from the study area in Appendix Table A-8 and the location of sightings is shown in Figure 8.

Most of the elephant seal sightings reported in the study area have been made in areas where and when the salmon sport fishery is in progress or from beached animals. The species has not been reported in southern

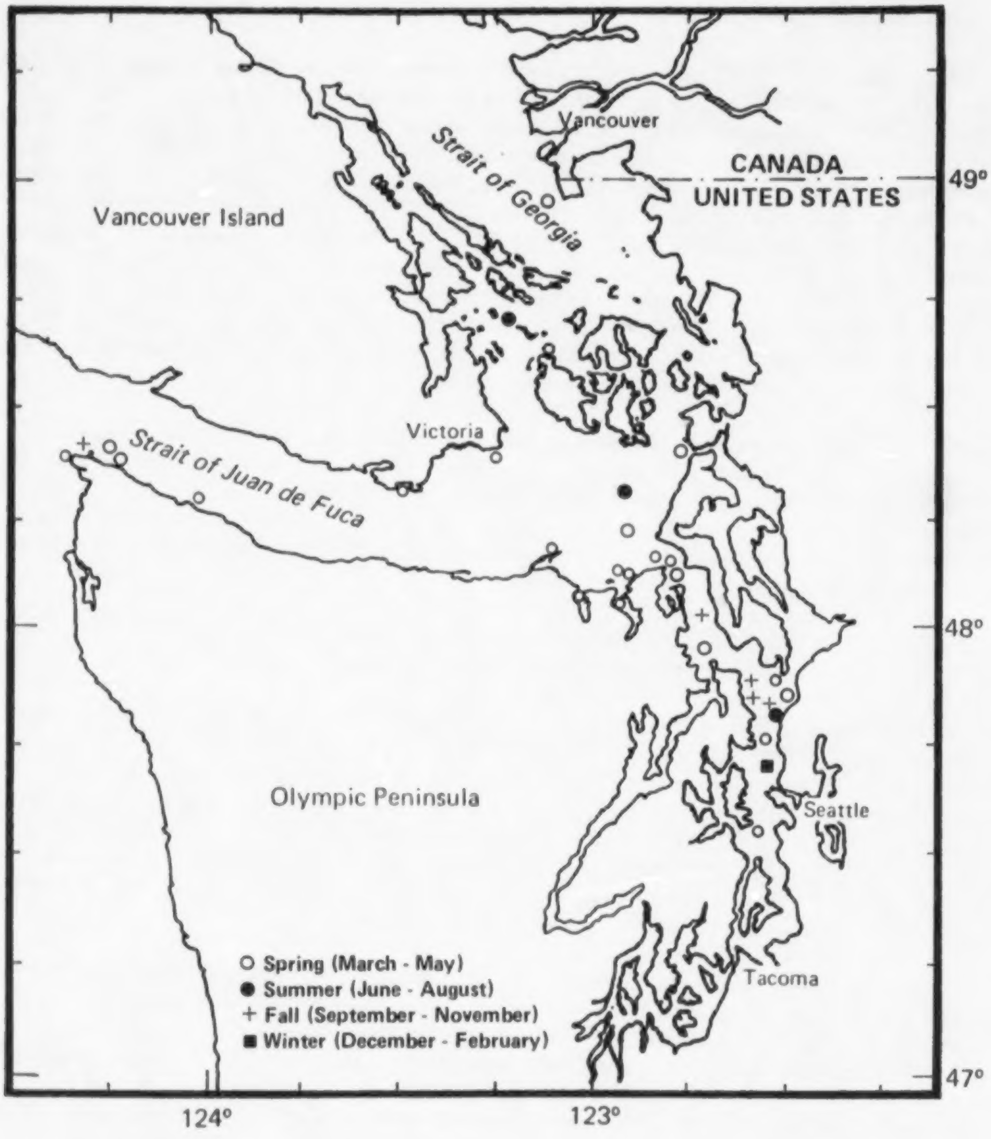

Vancouver
CANADA
UNITED STATES
Strait of Georgia
Vancouver Island
Victoria
Strait of Juan de Fuca
Olympic Peninsula
Seattle
Tacoma
○ Spring (March - May)
● Summer (June - August)
+ Fall (September - November)
■ Winter (December - February)
49°
48°
47°
124°
123°

Figure 8. Locations where elephant seal (Mirounga angustirostris) were sighted in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca (Table A-8).

Puget Sound south of Bainbridge Island, and no records are known north of the San Juan Islands or the eastern bays. Pike and MacAskie (1969) list records from Hecate Strait and Queen Charlotte Sound but none for the eastern side of Vancouver Island.

Order Mysticeti

There are 10 recognized species of baleen whales, separated into five genera and three families in the order Mysticeti (Rice 1977). Seven of these species have been reported from the offshore, coastal, and inside waters of Washington: gray whale (*Eschrichtius robustus*), minke whale (*Balaenoptera acutorostrata*), sei whale (*Balaenoptera borealis*), fin whale (*Balaenoptera physalus*), blue whale (*Balaenoptera musculus*), humpback whale (*Megaptera novaeangliae*) and the right whale (*Balaena glacialis*). All baleen whales are protected in U.S. waters by the Marine Mammal Protection Act of 1972, and all but the minke whale are protected by the Endangered Species Act of 1973.

Only four of the seven species reported from Washington waters have been identified from Puget Sound, the San Juan Islands, or the Strait of Juan de Fuca although it is possible that there may be one record of a blue whale from Puget Sound. The four species reported from the study area are discussed individually and sighting records are given below.

Gray whale (*Eschrichtius robustus*)

There are two stocks of gray whales in the North Pacific Ocean--the western stock, which is found in the Sea of Japan and the Okhotsk Sea, is nearly extinct and the eastern stock, which ranges from the Gulf of California northward along the Pacific Coast of the United States and Canada through the Bering Sea and into the Chukchi Sea where the largest portion of the population spends the summer and fall months (Rice 1977).

Gray whales are sexually mature at about age 8. The mean length of physically mature males is 13.0 m, of females 14.1 m. The female bears a single calf once every 2 or more years after a 13-month gestation period. The calf is about 4.9 m long at birth, and on weaning 7 months later is about 8.5 m in length (Rice and Wolman 1971; NMFS 1979).

This species is readily identified by its overall mottled gray color and abundant white barnacle growth, giving it a mottled gray and white appearance. This species has no dorsal fin, only a low hump which is followed by a series of knobs along the dorsal ridge towards the tail. It is the only large whale that regularly travels close to shore, at times in the outer breakers of the surf. During migration it is frequently sighted in the entrances of Washington rivers and bays and solitary animals may venture inside. This behavior pattern is not considered unusual as they normally enter the shallow bays and lagoons of Baja California to calve in winter.

The eastern North Pacific stock of gray whales was estimated to number about 15,000 animals prior to exploitation (Henderson 1972). The population had been greatly reduced in numbers by whalers in the early 19th century and was finally given complete protection in 1947 (NMFS 1979). By 1967, the population had responded to the protection given it 20 years earlier and was estimated to contain about 11,000 animals. Present estimates range from 11,000 to 15,000 and it is thought that the population has stabilized at this level (Rice and Wolman 1971; Rugh and Braham 1979).

Most feeding takes place on the summer grounds in the Chukchi Sea, with apparently little feeding on southbound migration or on the wintering grounds (Rice and Wolman 1971). Gray whales feed primarily on the dense masses of benthic amphipods although they may occasionally take euphausiids, copepods, etc., and the smaller schooling fishes that they encounter in the feeding areas.

In the early 1970s, Ken Balcomb (Moclips Cetological Society) recovered the remains of many small fish from the throat of a gray whale that stranded near Moclips, Washington. The fish vartebrae were tentatively identified by Hiroshi Kajimura and Clifford Fiscus (NMML) as rainbow smelt, Osmerus mordax. L. Tsunoda pers. commun. (NMML) reported crab zoea Cancer spp. in the stomach of a young gray whale that stranded and died at Edmonds, Washington on 20 June 1978.

The gray whale is primarily a coastal animal, being found during most of the year in shallow coastal waters, often within sight of land. In Washington waters, virtually the entire population passes northward in March and April on their way to the Chukchi Sea summer grounds, returning southbound in late November to early January on their way to the calving grounds in the coastal bays and lagoons of Baja California Mexico. There is some variation in the timing of these migrations in Washington coastal waters, and a few gray whales have been sighted during most months of the year (Wilke and Fiscus 1961; Pike and MacAskie 1969; Wahl 1977; Everitt and Jeffries 1979). A small population is found in summer off the west coast of Vancouver Island, British Columbia (Hatler and Darling 1974). The location and season of the year when gray whales have been sighted in the study area are shown in Figure 9 and listed in Appendix Table A-9.

In the study area, there has been at least one sighting of a gray whale during each month of the year. Most sightings were of single animals, although at least 12 sightings were made of two animals. In 1978 a group of five was reported off Clallam Bay in the Strait of Juan de Fuca, and in 1979 2 sightings, probably of the same group, which may have contained as many as 15 animals, were made in the entrance to Hood Canal and off Port Townsend.

Stragglers from the coastal migrations may enter the study area, probably most frequently during the northbound migration, and some may remain in these waters for extended periods of time before moving on. The number of gray whales that enter the study area is presently quite small and probably numbers less than 25, except in the western Strait of Juan de Fuca

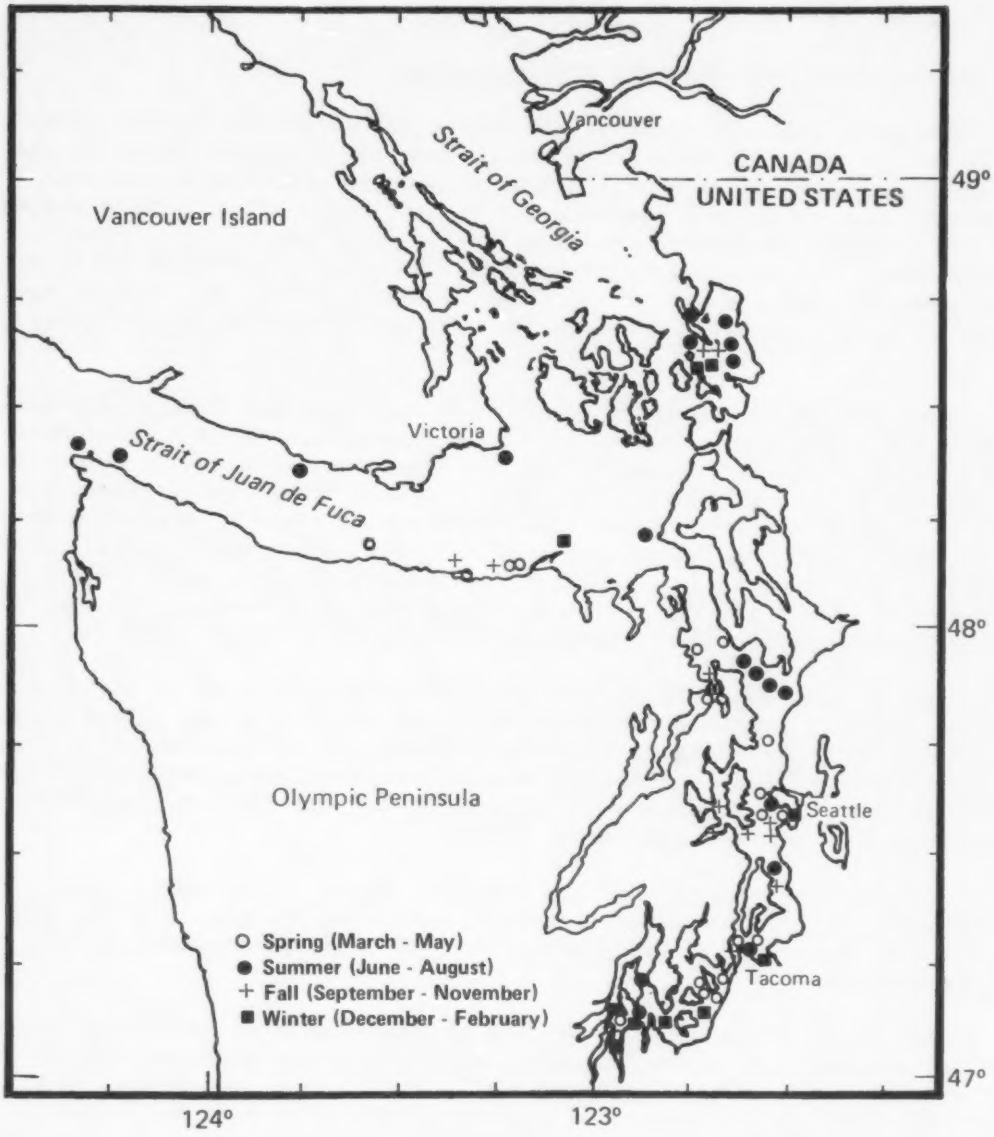

Vancouver
CANADA
UNITED STATES
49°
Strait of Georgia
Vancouver Island
Victoria
Strait of Juan de Fuca
48°
Olympic Peninsula
Seattle
Tacoma
○ Spring (March - May)
● Summer (June - August)
+ Fall (September - November)
■ Winter (December - February)
47°
124°
123°

Figure 9. Locations where gray whales (Eschrichtius robustus) were sighted in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca (Table A-9).

where migrating animals cross the strait from Tatoosh Island, Washington to Pachena Point Vancouver Island, British Columbia as reported by Hatler and Darling (1974).

Minke whale (Balaenoptera acutorostrata)

The minke whale is found in all waters of the world. In the eastern North Pacific Ocean, this species ranges from the ice-free waters of the Arctic Ocean south to Baja California, Mexico, in summer and in winter generally from California south to the Equator (NMFS 1979). Minke whales are the smallest members of the genus Balaenoptera and in the northern hemisphere do not exceed 10 m in length. They attain sexual maturity at 7 to 8 years of age, when males are about 7.0 m in length, and females are about 7.9 m in length. Mature females usually bear a single calf every year.

Minke whales seldom surface more than once or twice before sounding. Usually the first and only view of a minke whale is that of a small dark whale with a slightly falcate dorsal fin appearing ahead of the vessel and quickly submerging with no visible blow. If the observers are fortunate, they may see one or more minkes cruising a bay or passage, appearing at 10 to 20 minute intervals in their search for prey; again the blows are seldom visible. Most frequently in springtime this whale may be seen breeching (jump clear of the water), and at this time the white band across the flipper is visible making identification of the species beyond question.

This species was seldom taken by whalers operating out of Washington or British Columbia stations (Scheffer and Slipp 1948; Pike and McAskie 1969), and its feeding habits in U.S. waters are unknown; however, in other areas, euphausiids, copepods, squids, and small schooling fishes have been reported and these same food items are probably consumed here (Scattergood 1949; Omura and Sakiura 1956; and Nemoto 1959).

Minke whales inhabit both the offshore waters of the world oceans and protected waters such as Puget Sound, the San Juan Islands, and the Strait of Juan de Fuca. In the study area, they are the most abundant baleen whale reported.

Most observations of this species in the study area (62.2%) were made during the spring and summer months, although we have sighting records from all months except February and November. The location and season of the year when minke whales have been sighted in the study area are shown in Figure 10 and listed in Appendix Table A-10.

The reduction in number of fall and winter observations may reflect a reduction in sighting effort rather than a seasonal reduction in numbers, although some southward migration must undoubtedly occur. In spring and summer, most sighting reports are from the San Juan Islands area and the eastern Strait of Juan de Fuca in the vicinity of Partridge, Hein, and Middle Banks. Boran and Osborne (1978) report that most sightings by the public are made from April to September.

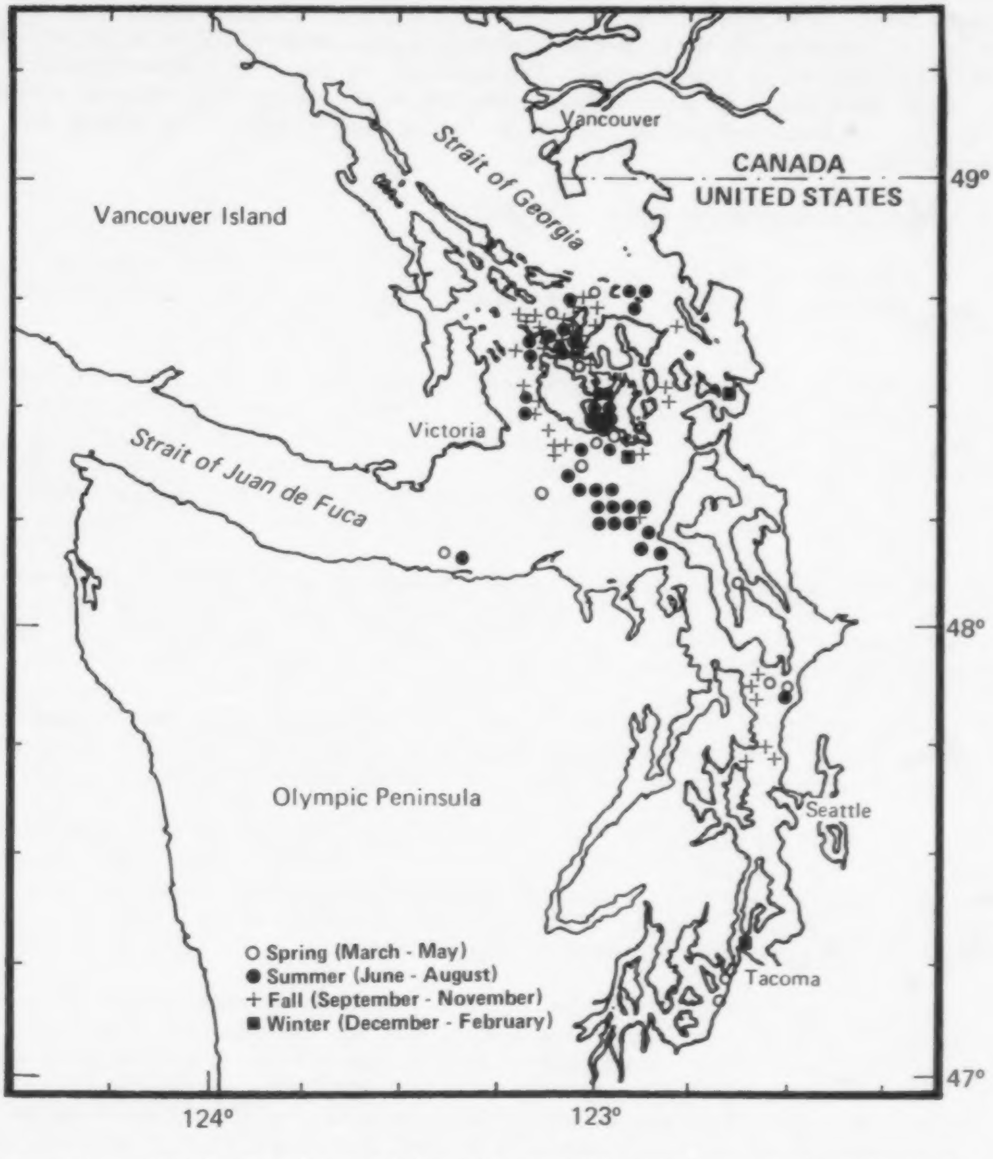

Vancouver
Strait of Georgia
CANADA
UNITED STATES
49°
Vancouver Island
Victoria
Strait of Juan de Fuca
48°
Olympic Peninsula
Seattle
Tacoma
○ Spring (March - May)
● Summer (June - August)
+ Fall (September - November)
■ Winter (December - February)
47°
124°
123°

Figure 10. Locations where minke whales (Balaenoptera acutorostrata) were sighted in Puget Sound, the San Juan Islands, and the Strait of Juan de Fuca (Table A-10).

No estimates have been made of the numbers of minke whales in the study area. Based on sighting reports, it is most abundant in spring, summer, and fall; and most observations are of single animals although reports of two animals occur with regularity. Scheffer and Slipp (1948) summarized the historical records of this species in Washington waters and Everitt et al. (1979) listed recent strandings. The species is certainly more abundant in the study area than in central and southern Puget Sound and is most abundant in spring, summer, and fall. It is probable that a few minke whales may be present year-round.

Fin Whale (*Balaenoptera physalus*)

In the eastern North Pacific Ocean the fin whale ranges from the Chukchi Sea south to California in summer and south into tropical waters in winter.

Fin whales are second in size only to the blue whale and in the northern hemisphere may reach 23.2 m in length. They are sexually mature at 6 to 12 years. The mean length of mature males is 17.7 m, and females 17.3 m. The female bears a single calf every 2 to 3 years after a one-year gestation period. The calf is weaned at about 7 months of age. Mating and calving occur in winter (NMFS 1979).

Fin whales usually travel in small groups of 2-5 animals. They are readily recognized by their large size, brownish-gray back and white belly, and well developed dorsal fin. It is primarily an offshore species, seldom venturing near land in Washington waters.

The North Pacific population, before it was exploited, was estimated to be about 44,000 and presently numbers about 17,000 animals. The species is completely protected in the North Pacific Ocean (NMFS 1979).

Fin whales feed primarily on euphausiids, although they have been reported to feed on some of the smaller schooling fishes such as anchovy (*Engraulis mordax*), small pollock (*Theragra chalcogramma*), and capelin (*Mallotus villosus*). Simenstad et al. (1979) describes in considerable detail the prey species consumed by this species.

Scheffer and Slipp (1948) report the fin whale ranked second in numbers taken off Washington by whalers operating out of the Bay City station from 1911 to 1925 and report it was taken by the Makah Indians in the 19th century. It was formerly seen in Hecate Strait and Queen Charlotte Sound (Pike and McAskie 1969) and about the entrance to the Strait of Juan de Fuca in the mid-19th century by Scammon (Scheffer and Slipp 1948); however, the heavy commercial harvest has reduced the probability of sighting this species in these waters.

There are no recent observations from the study area; the two records reported by Scheffer and Slipp (1948), one in 1915 near Tacoma and one at Shelton in 1930, remain the only records from inside waters. Since the fin whale is primarily an offshore species whose numbers are still much reduced from the pre-exploitation total, there is little likelihood of its occurring other than as a rare straggler in the study area. Any new sightings are most likely to occur about the entrance to the Strait of Juan de Fuca.

Humpback Whale (*Megaptera novaeangliae*)

The population of humpback whales in the North Pacific Ocean may have several discrete stocks. In the eastern North Pacific Ocean it ranges from the Chukchi Sea south to California in summer and south into southern Mexican waters and Hawaii in winter.

Humpback whales reach sexual maturity at 6 to 12 years of age. Mature males are about 11.6 m in length, females about 11.9 m. Females rarely bear calves two years in succession. The mating and calving season is from October to March in the northern hemisphere. The gestation period is 12 to 13 months; the single calf nurses about 11 months.

Humpbacks usually travel in large groups; before stocks were greatly reduced it was not uncommon to see groups ranging in size from 25 to several hundred in northbound migration in the Gulf of Alaska and along the Alaska peninsula. They are easily recognized by their stocky appearance, stubby, nondescript dorsal fin, exceedingly long, usually white pectoral fins, and their habit of breeching and lobtailing.

Before exploitation, population size in the North Pacific Ocean was about 15,000. The population was heavily hunted in the 20th century by shore whalers of the United States and Canada and the oceanic fleets of Japan and the U.S.S.R. This population is now estimated to contain about 850 animals (NMFS 1978), and enjoys complete protection.

The humpback whale feeds primarily on euphausiids but does take some of the smaller schooling fishes on occasion. The technique known as bubble-net feeding has been used for trapping prey such as herring in southeastern Alaska (Wolman 1978). Simenstad et al. (1979) listed four species of euphausiids and four species of small schooling fishes found in the stomachs of humpback whales taken in the eastern North Pacific Ocean.

During the period 1911-1925, when whalers operated in Washington waters from the Bay City station, the humpback formed a major portion of the catch (Scheffer and Slipp 1948). During the early 1900's, humpback whales were regularly reported from the inside waters of Washington, including southern Puget Sound (Scheffer and Slipp 1948). This species, perhaps more often than any of the other large whales, is regularly found at some seasons of the year in inside protected waters. It is a resident in summer and early fall of certain inside waters of southeastern Alaska and Prince William Sound and as its numbers increase will probably again be regularly seen in the study area. Recent sightings of this species in Puget Sound were made off Seattle, Washington in May 1976 (two individuals) and again off Seattle in September 1978 (four individuals) (Everitt et al. 1979).

Order Odontoceti

There are 65 recognized species of toothed whales, which are separated into 34 genera and 5 families, in the Order Odontoceti (Rice 1977). Seventeen of these species have been reported from the offshore, coastal, and inside waters of Washington: striped dolphin (*Stenella coeruleoalba*), saddleback dolphin (*Delphinus delphis*), Pacific whiteside dolphin (*Lagenorhynchus obliquidens*), northern right-whale dolphin (*Lissodelphis borealis*), whitehead grampus (*Grampus griseus*), false killer whale (*Pseudorca crassidens*), short fin pilot whale (*Globicephala macrorhynchus*), killer whale (*Orcinus orca*), harbor porpoise (*Phocoena phocoena*), Dall's porpoise (*Phocoenoides dalli*), belukha (*Delphinapterus leucas*), sperm whale (*Physeter macrocephalus*), pygmy sperm whale (*Kogia breviceps*), North Pacific giant bottlenose whale (*Berardius bairdii*), goosebeak whale (*Ziphius cavirostris*), arch-beaked whale (*Mesoplodon carlhubbsi*), and the Bering Sea beaked whale (*Mesoplodon stejnegeri*). All toothed whales are protected in United States waters by the Marine Mammal Protection Act of 1972, and the sperm whale by the Endangered Species Act of 1973.

Of the seventeen species reported from Washington waters, twelve have been reported from Puget Sound, the San Juan Islands or the Strait of Juan de Fuca, or adjacent waters. These twelve and the beaked whales are discussed individually and sighting records are given.

Saddleback Dolphin (*Delphinus delphis*)

The population of the saddleback dolphin in the eastern North Pacific Ocean ranges from about the California-Oregon boundary south to Costa Rica and may be composed of at least two separate stocks. This species is the most abundant cetacean in California waters. Green (in press) estimated a population of 243,000 dolphins in the California current system; however, this is probably an overestimate. The center of abundance for this species is off southern California. We know of only two records of its occurrence off Washington, one found dead at Pacific Beach, Washington in February 1942 (Scheffer and Slipp 1948) and one found dead at Victoria, British Columbia, Canada on 8 April 1953 (Guiguet 1954). There have been no stranding reports or sightings of this easily identified dolphin except the two previously mentioned ones, and in the past 20 years observation effort off the Washington coast and in the waters of the study area has increased tenfold with no additional sightings. The saddleback dolphin can be considered as accidentally occurring in the study area and of no significant importance to the area's ecosystem.

Pacific Whiteside Dolphin (Lagenorhynchus obliquidens)

In the eastern North Pacific Ocean this species is found from Baja California, Mexico northward to Washington and British Columbia in winter and north into the Gulf of Alaska in summer. It regularly frequents the waters of the Continental Shelf and slope but has been sighted in large schools far offshore (NMFS 1978). Pike and MacAskie (1969) report schools of 200 to 250 animals from Hecate Strait and Fitzhugh Sound from October to January and suggest an inshore movement in winter and an offshore movement in summer. Cowan and Guiguet (1965) report the regular occurrence of this species in small numbers from the Strait of Georgia and in the Strait of Juan de Fuca. Strandings of this species are frequently reported from the Washington coast (Scheffer and Slipp 1948). The only specimen taken in the study area was a pregnant female which was taken from the middle of the Strait of Juan de Fuca off Race Rocks, British Columbia on September 1936 by the research vessel Catalyst (Scheffer and Slipp 1948). We have a report of seven Pacific whiteside dolphins seen on 5 September 1975 in Admiralty Inlet north of Foulweather Bluff. No confirmed sightings were made of this species during the present study; however, an unconfirmed hot line report of 200 Dall's porpoise sighted west of Stuart Island in Haro Strait on 22 March 1979 may have been Pacific whiteside dolphins. Stroud et al. (in press), commenting on the pod size of Dall's porpoise, state that of 868 pods observed (3,575 individuals), each was generally comprised of less than 20 animals and most contained 3 to 5. From recent sightings (Table A-12) in the study area, we obtained an average pod size of 8.5 Dall's porpoise and a range of from 1 to 28.

The Pacific whiteside dolphin, which may be the most abundant small cetacean north of California, may reach 2.3 m in length and a weight of 181 kg. It is easily recognized by its dark gray back and shades of light gray and white making a striped effect on its sides, its prominent recurved fin, the posterior portion of which is white, and short ill-defined beak which would be unnoticeable in free swimming specimens. No report was made on the contents of the stomach of the one dolphin collected in the study area; however, the stomachs of 11 dolphins collected off the coast of Washington in 1968 and 1972 included Pacific lamphrey (Entosphenus tridentatus), salmon, Oncorhynchus spp., (all immature), unidentified fish, and eight species of squid (Stroud et al. in press). This dolphin feeds primarily on epipelagic schooling fishes and squids.

We consider this species as rare in the study area and most likely to be sighted in the Strait of Juan de Fuca. Its impact on the ecosystem is insignificant.

Whitehead Grampus (Grampus griseus)

The whitehead Grampus (Risso's dolphin) is found in the eastern North Pacific Ocean from British Columbia south to the tropics (NMFS 1978). There are no estimates of abundance for this species although it has been described as uncommon but not rare throughout its range (NMFS 1978). It has been sighted off Washington and British Columbia in April, July, August, September, and October (Everitt et al. 1979, Pike and MacAskie 1969, and Wahl 1977). There are four stranding records: in May 1964, near Prince Rupert British Columbia; April 1967, Mukkaw Bay, Washington; April 1970, west coast Vancouver Island, British Columbia; and in March 1975, in the study area at Port Discovery (Pike and MacAskie 1969, Everitt et al. 1979).

The whitehead Grampus may reach 4 m in length. It is usually sighted in small groups although one group of 200 was sighted off Washington in April 1972 (Everitt et al. 1979). It is recognized by its blunt head, dorsally mottled gray body, with white scars and a white head in adults, the white presumably extending further back on the body as the animal grows older, and relatively tall, slightly falcate dorsal fin.

The measurements of the Port Discovery specimen are given in Everitt et al. (1979) and of the Mukkaw Bay specimen in Stroud (1968). The stomach of the Mukkaw Bay specimen contained squid remains representing at least seven different groups (Stroud 1968). This species is primarily an inhabitant of the offshore waters, and we consider the one sighting and stranding in the study area as an accidental occurrence and of negligible importance to the area ecosystem.

False Killer Whale (*Pseudorca crassidens*)

This species ranges the temperate and tropical seas and in the eastern North Pacific Ocean may rarely move north of California waters. Most sighting records are from southern California southward (NMFS 1978; Scheffer 1978).

Adult animals may reach 1,360 kg in weight and a length of 6.1 m (males) and 4.9 m (females). The one Washington specimen which was taken in southern Puget Sound near Olympia on 15 May 1937, sex unknown, was about 5.4 m in length and weighed 900 kg (Scheffer and Slipp 1948).

The stomach of the Puget Sound specimen contained a few salmon vertebrae. In other parts of its range it feeds on fish and squid considerably larger than the prey consumed by the Dall's and harbor porpoises which are resident in the study waters. The occurrence of the false killer whale is accidental and of no significant importance to the area ecosystem.

Short-finned Pilot Whale (*Globicephala macrorhynchus*)

In the eastern North Pacific Ocean this species ranges from the Gulf of Alaska south into the tropical seas but is most frequently sighted from about central California south. The northernmost stranding record of this species was reported by Orr (1951) of an animal that washed ashore dead near Kanatak on the Alaska peninsula in 1937. Pike and MacAskie (1969) report three juveniles, one of which was collected, that were taken in a gillnet by a salmon research vessel in Lat. 50°N, Long. 145°W, on the night of 29-30 June 1957. In Washington, the first state record is that of a dead pilot whale which washed ashore near Queets about 1 September 1937 (Scheffer and Slipp 1948). The only record from the inside waters of Washington is that of a male 3.05 m in length which was captured alive in Pleasant Harbor, Hood Canal, in March 1968 and died in captivity 6 days later at Seattle, Washington; its measurements are given in Everitt et al. (1979). In the three seasons that the public cetacean reporting system or "Whale Hotline" has been in operation, pilot whales were reported only in 1978 (Boran and Osborn 1978); these sightings are listed in Everitt et al. (1979). Pike and MacAskie (1969) report a similar situation in 1958 which suggests that only infrequently do pilot whales venture into these northern waters.

Pilot whales grow to 4.6 to 6.7 m in length (NMFS 1978). They are easily recognized by the bulbous forehead, usually entirely black body, and broadbased, relatively short dorsal fin, and long narrow pectoral fins. They are relatively slow moving and usually make a series of short surface dives before descending for a longer period and usually travel in pods rather than singly. We consider the short-finned pilot whale to be rare in the study area and of negligible importance to the area's ecosystem.

Killer Whale (Orcinus orca)

The killer whale ranges the world's oceans north and south to the permanent ice, being more abundant in colder waters (NMFS 1978). It has been the object of more controversies and research than any other marine mammal in the Strait of Juan de Fuca, the San Juan Islands area, and other inside waters of Washington and British Columbia.

Killer whales may reach a length of 8.2 m (males) and 7.0 m (females). Males may weigh as much as 8,000 kg, females about 4,000 kg. The dorsal fin of the males may reach a length of 1.8 m, while that of the females is less than half that size. Balcomb et al. (1979b) have observed that juvenile whales remain in their pod of birth for at least 6 years and are still sexually immature. Their observed calving interval for adult females is one every 3 to 4 years, and they report a birth rate of 12.5%/adult female per year.

Bigg (1979), using a technique of photographic identification of individual killer whales in the waters of British Columbia and Washington, estimated a summer population of at least 230 individuals (21 pods usually numbering from 10 to 20 whales). He lists 3 pods, totaling 80 whales, as year-round residents of the waters of the Strait of Georgia, Puget Sound the Strait of Juan de Fuca including the San Juan Islands, and coastal areas off Vancouver Island B.C., and Washington.

Balcomb et al. (1979b) describe studies initiated by the National Marine Fisheries Service and carried out primarily by Balcomb and his colleagues since 1976 in Greater Puget Sound, the name he applies to all protected inside waters of Washington, the northern portion of which is the area of the present study. Balcomb et al. (1979b) agree with Bigg (1979) in listing 3 pods as regular inhabitants of the area, being present during all months in 1978, and having sighting records for 47% of the days of the year.

Balcomb et al. (1979a) have summarized sighting records gathered by the Moclips Cetological Society, "Orca Survey hot line," and many hours of personal observation for the Greater Puget Sound area from 1976 through 1978. Over 1300 sightings of killer whales were made in all areas of these waters. Sighting observations gathered during this study were regularly turned over to Orca survey for incorporation into that data base. Balcomb et al. (1979a), found that the killer whale spends more time in the San Juan Islands area (31%) than in other parts of the region.

During the years 1961-76 when whales were taken and sold for display in the world's aquaria, many of the animals comprising the pods that regularly live in adjacent British Columbia and Washington waters may have been captured on more than one occasion (Bigg and Wolman 1975), Asper and Cornell 1977). The preexploitation size of the population which spends some time in the study area may have been about 130. Bigg and Wolman (1975) report 62 whales captured and removed; most probably from this population. In 1976, when regular counts began, the population in the study area consisted of 68 animals and by 1979 it had grown to more than 80 animals through births in the pods (Balcomb et al. 1979a).

Movements of two of the pods inhabiting the waters of the study area are shown in Everitt et al. (1979). Balcomb et al. (1979a) describe in detail movements of all pods in the area. Killer whale pathways of importance in the study area include Haro Strait, the most traveled route between the Strait of Juan de Fuca and the Strait of Georgia; Rosario Strait, connecting the two Straits, northern Puget Sound and the eastern bays; and Admiralty Inlet, the gateway to central Puget Sound.

The stomach contents of 10 killer whales taken in the eastern North Pacific Ocean in recent years (Rice 1968) include: California sea lion, northern sea lion, elephant seal, harbor porpoise, Dall's porpoise, minke whale, opah, Lampris regius, Pacific halibut, carcharinid shark, and one squid. Scheffer and Slipp (1948) list the following as food of killer whales in Washington waters: harbor seal, greenling, ling cod, salmon, and squid. Hancock (1965) observed a pod of seven killer whales attack and kill an adult minke whale (8.4 m long) in Barkley Sound, Vancouver I., B.C. on 26 May 1964. When the carcass was recovered the next day it was found that the killer whales had neatly removed and presumably eaten the skin from the entire body, the tongue, dorsal fin, and flesh from the lower jaw.

Scheffer and Slipp (1948) and Balcomb et al. (1979a) both describe the effect of killer whales on salmon schools and comment on their appearance in certain areas when the salmon runs are in progress. Balcomb et al. (1979a) state that killer whales predominately eat salmon in the study area and estimate that the whales' hypothetical share of the salmon fishery was 3 to 6%. They also report on prey items observed by them in the area in recent years other than salmon as follows: rockfish, cod, salmon, harbor porpoise, harbor seal, and elephant seal. Salmon, when present, do form a significant part of the killer whale's diet. Killer whales do impact the ecosystem, and must be considered to play a significant role in the study area.

Harbor Porpoise (*Phocoena phocoena*)

This species ranges from about Point Conception, California, north to the Arctic Ocean in the eastern North Pacific Ocean, primarily in coastal waters, although, there are a few records of sightings offshore (NMFS 1978). The harbor porpoise is a year-round resident of Washington coastal and protected waters, and is most frequently seen in the entrances of streams, harbors, and bays. Wahl (1977) regularly sighted the harbor porpoise in the Grays Harbor, Washington, entrance channel. On file at the NMML are over 30 sightings of this species in Washington coastal waters. Frequent sightings of this species have been made in the nearshore waters from Cape Flattery south to LaPush during all seasons of the year.

The harbor porpoise ranges throughout the waters of the Strait of Juan de Fuca, the San Juan Islands area, and south into Puget Sound. It has been sighted in the study area during all months of the year (Fig. 11, Table A-11), and its present center of abundance is in the Strait of Juan de Fuca and the San Juan Islands area. The area about Freshwater Bay west of Port Angeles may be important to the harbor porpoise in fall and winter. It was formerly abundant in southern Puget Sound (Scheffer and Slipp 1948) but is now seldom seen (Everitt et al. 1979). L. Tsunoda, NMML (pers. commun.) reported the death of a harbor porpoise in a gillnet in Carr Inlet in September 1979, the first recent record of this species from southern Puget Sound.

Harbor porpoise may reach 1.8 m in length and weigh up to 72 kg. Females are sexually mature at 3 to 4 years of age, the gestation period is 10 to 11 months, and calves nurse up to 8 months (NMFS 1978). Scheffer and Slipp (1948) list lengths and weights of 6 adult females from Washington waters. Lengths ranged from 1.56 to 1.78 m and weighed from 53.9 to 75.2 kg. A male stranded near Poulsbo, Washington on 5 January 1971 was 1.5 m in length (Everitt et al. 1979). Pike and MacAskie (1969) list a sexually mature male that measured 1.47 m.

The harbor porpoise is usually shy and inconspicuous and is easily missed by the casual observer. It is the smallest cetacean found in our waters, is gray to black dorsally, shading to light gray and white ventrally. Its low triangular dorsal fin is quite different from the fin of any other cetacean likely to be seen in the study area. Harbor porpoise can be frequently seen working the tide rips in apparent search for prey.

Although no estimate can be made of the numbers of harbor porpoise in the study area, it is probably equally as numerous as the killer whale. The continual incidental take of this species by commercial fishermen in salmon gill nets is the most serious factor affecting the growth of this

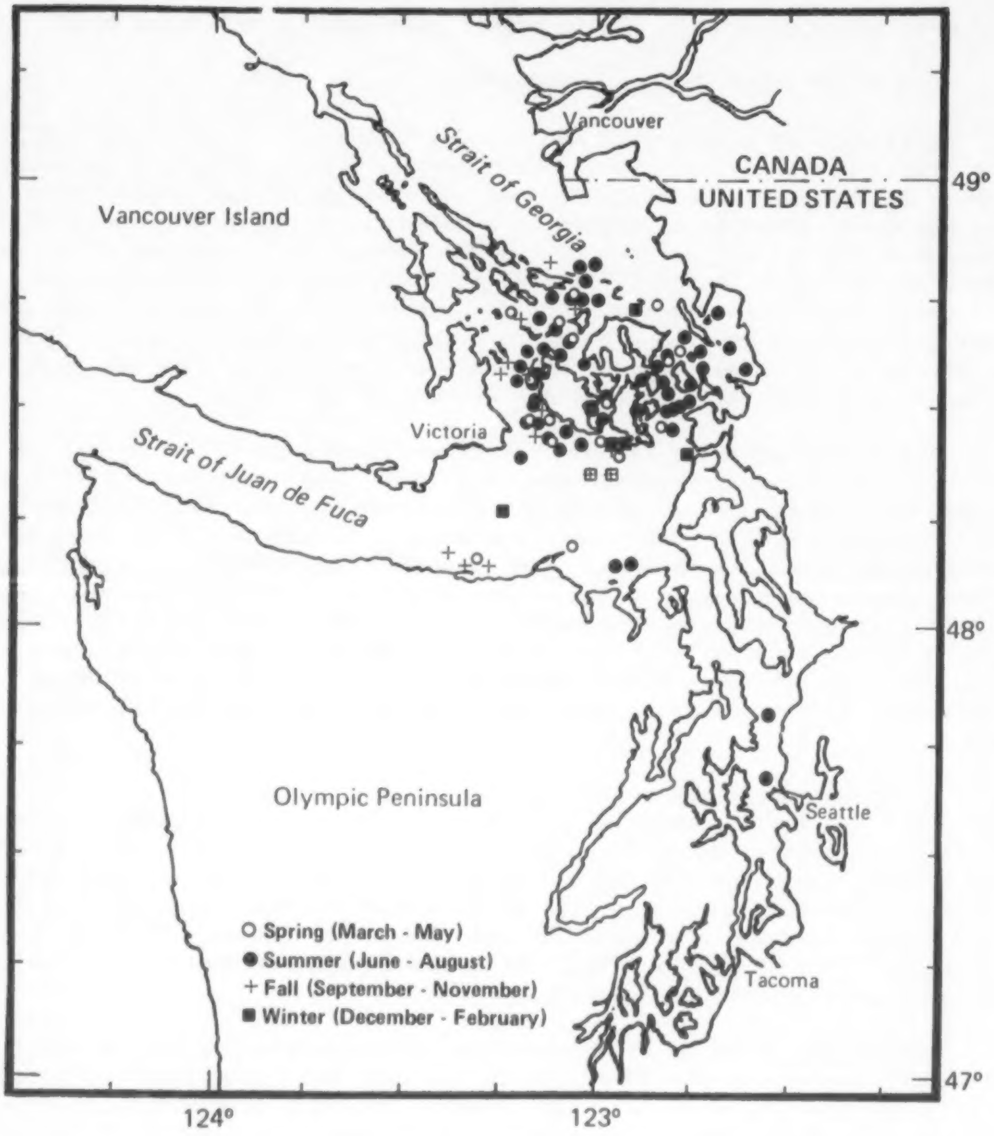

Vancouver
CANADA
UNITED STATES
49°
Vancouver Island
Strait of Georgia
Victoria
Strait of Juan de Fuca
48°
Olympic Peninsula
Seattle
Tacoma
○ Spring (March - May)
● Summer (June - August)
+ Fall (September - November)
■ Winter (December - February)
47°
124°
123°

Figure 11. Locations where harbor porpoise (Phocoena phocoena) were sighted in Puget Sound, the San Juan Islands, and the Strait of Juan de Fuca (Table A-11).

population in the study area, although killer whales do take some porpoise as prey. The part the harbor porpoise plays in the ecosystem of the study area is unknown; it feeds primarily on the smaller schooling fishes and may exhibit some migratory behavior in response to seasonal movements of prey. In Washington waters herring and capelin have been found in their stomachs (Wilke and Kenyon 1952; Scheffer 1953). It may be sensitive to pollutants, which could account for the decline of its members in southern Puget Sound. Its center of abundance lies directly in the vessel traffic lanes through the eastern Strait of Juan de Fuca and into northern Puget Sound and through the San Juan Islands to Vancouver, Bellingham, and Anacortes.

Dall's Porpoise (*Phocoenoides dalli*)

The Dall's porpoise inhabits the subarctic waters of the North Pacific Ocean. In the eastern North Pacific Ocean it ranges from the Bering Sea south to Baja California, Mexico, and is a year-round resident from about Point Conception, California, north to the Aleutian Islands (NMFS 1978). It is reported to be one of the most abundant cetaceans in the inside straits and sounds of Southeastern Alaska (NMFS 1978), and the exposed straits and sounds of British Columbia (Pike and MacAskie 1969). Pike and McAskie (1969) stated that this porpoise is abundant in the Strait of Juan de Fuca but seldom seen in enclosed waters such as the Strait of Georgia.

The Dall's porpoise ranges throughout the study area and south through Admiralty Inlet into central Puget Sound with a few stragglers occasionally penetrating into south sound; however, the center of abundance is in the Strait of Juan de Fuca east to the San Juan Islands (Fig. 12, Table A-12). This porpoise has been sighted in the study area during all months of the year. It is more abundant in the eastern Strait of Juan de Fuca in spring and summer than it is in fall and winter. It was sighted during vessel cruises in October, November, and December 1979 in the western Strait of Juan de Fuca and is probably present there during other months of the year as well. We have no sightings from the protected waters of Hood Canal or the waters east of Whidbey Island, which bears out the statement by Pike and MacAskie (1969) that this species is seldom seen in protected waters. The species has been sighted in Haro and Rosario Straits, but not north into the Strait of Georgia during this study. The numbers in groups of animals reported from various sources during this study ranged from single animals to 28 and averaged 8.5; however, a group of 200 was reported through the Orca survey hotline on 22 March 1979 from Haro Strait. We know of no sighting records of groups this large; Pike and MacAskie (1969), reporting on group size of 211 groups sighted in the inshore and offshore waters of British Columbia, listed only three groups that comprised from 50 to 100 animals and stated that approximately half the sightings were of groups numbering from 5 to 14 animals. We suggest that the large pod reported from Haro Strait may have been Pacific whiteside dolphins (see additional comments in that section).

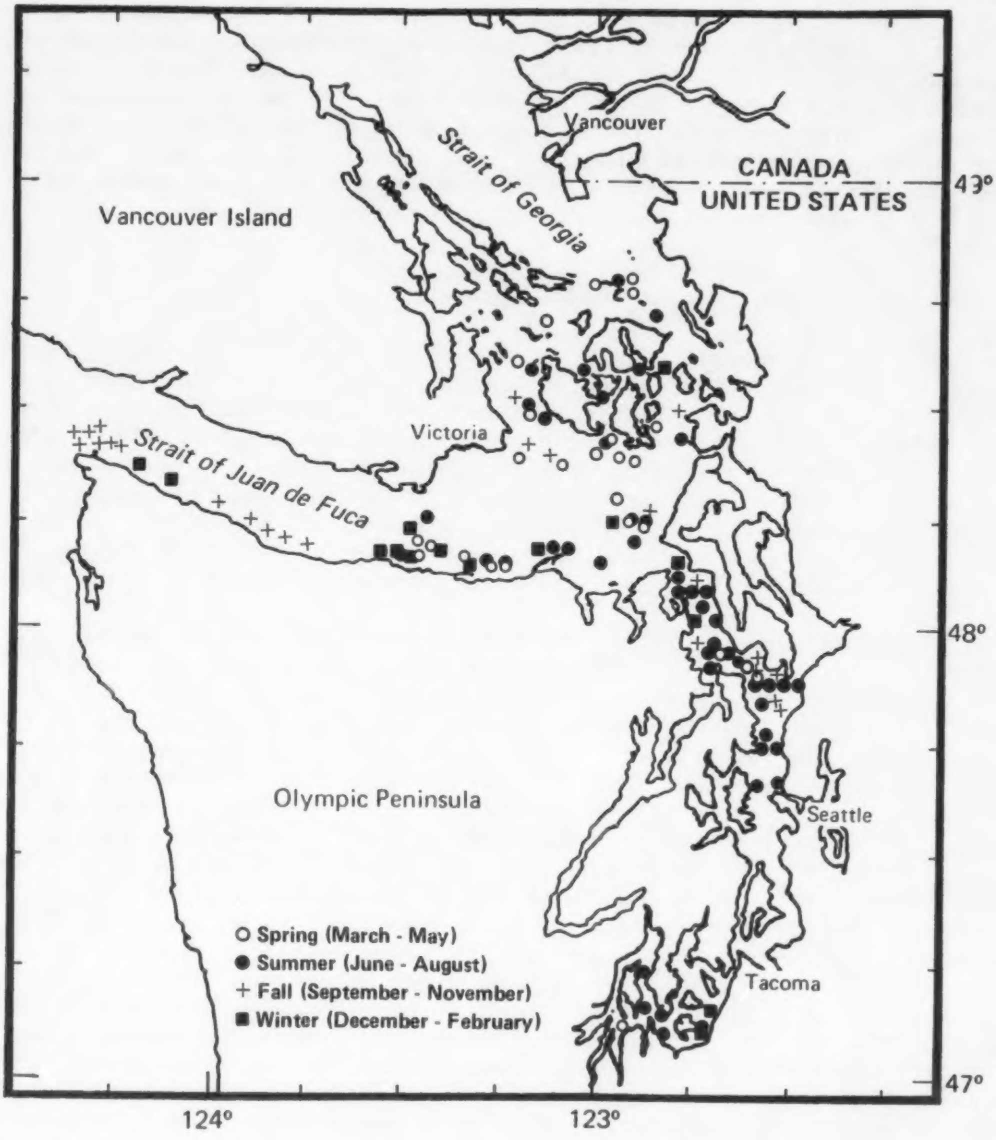

Vancouver
Strait of Georgia
CANADA
UNITED STATES
Vancouver Island
Victoria
Strait of Juan de Fuca
Olympic Peninsula
Seattle
Tacoma
○ Spring (March - May)
● Summer (June - August)
+ Fall (September - November)
■ Winter (December - February)
49°
48°
47°
124°
123°

Figure 12. Locations where Dall's porpoise (Phocoenoides dalli) were sighted in Puget Sound, the San Juan Islands, and the Strait of Juan de Fuca (Table A-12).

Jones et al. (1980) examined 611 porpoise in 1979, taken during the Japanese high seas salmon gillnet fishery in the western North Pacific Ocean and Bering Sea, and from a sample of 247 males gave a mean size of males collected as 187 cm, ranging in size from 91 to 218 cm. The heaviest male weighed 178 kg; the mean size among 385 females collected was 170 cm, with a range of from 130 to 218 cm. The heaviest female weighed 172 kg. Sexually mature females ranged in size from 160 to 218 cm.

The Dall's porpoise is one of the easier of the small cetaceans to recognize with its black upper body and white flanks and belly. Its dorsal fin is usually black with a white tip, and the tail flukes are usually edged with white. The distinctive splash that this porpoise makes when swimming at speed is unlike that of any other cetacean in the area, and when feeding, the prominant keel just forward of the tail is easily recognized.

The Dall's porpoise feeds primarily on small schooling fishes and squids in the epipelagic and mesopelagic zones of the ocean and may descend to the bottom (200 m or less) on occasion to feed on the smaller demersal fishes and octopods (Stroud et al. in press). Stroud et al. (in press) identified eulachon, rockfish (*Sebastes* spp.), sablefish, flatfish (Pleuronectidae), American shad (*Alosa sapidissima*), capelin, and the squids, (*Loligo opalescens*, Gonatidae, *Gonatus* sp., and *Onychoteuthis borealijaponicus*) from the stomachs of three porpoise (one of which was collected off Neah Bay in the Strait of Juan de Fuca) taken in Washington waters. Pike and McAskie (1969) and Cowan (1944) found herring in the stomachs of five porpoise taken in British Columbia waters. Many of these same species are present in the study area (Simenstad et al. 1979).

Dall's porpoise are year-round residents in the study area and although they may number less than killer whales, they are tertiary carnivores; but measured by mass alone, they do not impact the ecosystem to the degree that the killer whale does. This species is subject to incidental take in the commercial salmon gillnet fishery; two were reported taken in 1978 (Everitt et al. 1979). It is most abundant in the Strait of Juan de Fuca, and spends much of its time in the vessel traffic lanes.

White Whale (Belukha), *Delphinapterus leucas leucas* The white whale inhabits the Arctic Ocean and adjacent seas. In the eastern North Pacific Ocean this species has been reported south to Yakutat Bay in the Gulf of Alaska (Calkins and Pitcher 1977). Scheffer and Slipp (1948) report the sighting of a grayish white whale without a dorsal fin in April 1940 off point Defiance, Tacoma, and believe that the animal was indeed a white whale far from its normal range. The chance of this species being reported again from Washington waters is slight and we do not list it in Table 1. For a complete description of this species we refer the reader to NMFS (1978).

Pygmy Sperm Whale (*Kogia breviceps*)

The pygmy sperm whale is found primarily in tropical and subtropical seas, although stragglers have occurred in the eastern North Pacific Ocean north to Washington. It is reportedly rare throughout its range (NMFS 1978).

In Washington waters it is considered an offshore species. The first and only coastal record was that reported by Scheffer and Slipp (1948) of an animal that washed ashore south of Grayland, Washington in May 1942. The only record from protected waters of Washington is that of an animal that stranded near Oak Harbor, Whidbey Island, in October 1977 (Everitt et al. 1979). The stomach contents from this animal consisted of squids known to inhabit offshore waters, so there is little likelihood that this animal fed in the study area. We consider the occurrence of this species in the study area as accidental and as having no effect on the area ecosystem.

North Pacific Giant Bottlenose Whale (Berardius bairdii)

The North Pacific giant bottlenose whale is found only in the North Pacific Ocean and in the eastern North Pacific Ocean ranges from the Bering Sea south to southern California. It is an offshore species which was taken by whalers in April, May, July, and September off the Washington coast and from May through September off the British Columbia coast (Scheffer and Slipp 1948, Pike and MacAskie 1969). Wahl (1977) sighted six of these animals on 3 October 1976 WNW of Grays Harbor, Washington seaward of the continental shelf. There are two stranding records from Washington's outer coast; the first reported was between Queets and Kalaloch in the spring of 1939 (Scheffer and Slipp 1948), the second washed ashore one mile south of Ocean City in July 1950 (Slipp and Wilke 1953). The only record from the protected waters of Washington is that of a female 9.25 m in length which stranded in the study area near Port Townsend 6 December 1962 (Everitt et al. 1979). This species is described as uncommon but not rare throughout its range (NMFS 1978); however, there are no sighting records from the study area and its occurrence here can be considered as accidental with no impact on the area's ecosystem.

Goosebeak Whale (Ziphius cavirostris)

The goosebeak whale ranges the temperate and tropical seas (Rice 1977). Strandings of this species are not uncommon in the eastern north Pacific from the Aleutian Islands south to Baja California, Mexico (Mitchell 1968). One stranding of this species has been reported from the Washington coast, just south of LaPush, in February 1972 (Balcomb 1973). There are two records from the study area, one a badly decomposed adult male which washed ashore in January 1954 near the Jordan River on the south coast of Vancouver Island, British Columbia (Pike and McAskie 1969) and one of a skull found above the beach near Victoria, British Columbia (Cowan and Guiguet 1952). It is possible that both of the above mentioned specimens could have drifted in dead from offshore waters. There are no sighting records of this species from the study area and its occurrence here would be considered accidental.

Beaked Whales (Mesoplodon spp.)

There are no verified records of the Bering Sea beaked whale (Mesoplodon stejnegeri) or the archbeak whale (Mesoplodon carlhubbsi) from the study area and we list these species here, but not in Table 1.

Scheffer and Slipp (1948) list two strandings of *Mesoplodon* from the Washington coast, one stranded at Waatch River, Mukkaw Bay, in February 1942 and one which stranded near Oyhut and partially recovered on 2 November 1944. Moore (1966) examined most North American specimens and in his review of the genus identified the Waatch River specimen as *M. stejnegeri* and the Oyhut specimen as *M. carlhubbsi*. In May 1979, a *Mesoplodon* (later identified as *stejnegeri*) was recovered from a beach at Leadbetter Point, Washington (Scientific Event Alert Network 1979). This specimen, a male 4.3 m in length, was acquired by the University of Puget Sound Natural History Museum. Pike and MacAskie (1969) list four records for British Columbia, only one of which (a worn skull) was found on the east coast of Vancouver Island. They list both species from British Columbia.

Michael Bigg (Pacific Biological Station, Fisheries and Marine Service, Environment Canada, Nanaimo, B.C., pers. commun.) was called to investigate a small whale in Nanaimo Harbor on 5 August 1979. He observed the animal for several hours and obtained photographs. The animal, which later made its way out of the harbor, was tentatively identified as a *Mesoplodon* spp. by Bigg. It is probable that whales of this genus do transit the study area on rare occasions.

DISCUSSION

The occurrence of marine mammal species is summarized for five geographical regions: the Strait of Juan de Fuca (West I, East II) Haro Strait (III), Rosario Strait and the protected waters of the San Juan Islands (IV), and the bays east of these islands (V) (Figure 2). The relative seasonal vulnerability of these species to oil activities is discussed.

The effect of oil activities on the two marine mammal groups (cetacea and pinnipedia) is difficult to assess given the present state of knowledge on that subject. For the purpose of this discussion we consider these animals vulnerable when they are in areas associated with oil activities. For a review of the known physiological effects of oil on marine mammals see Everitt et al. (1979).

Cetaceans

It appears from available information (sighting information is scant for the winter months) that cetaceans (the orders Mysticeti and Odonoceti) occur with the greatest abundance and frequency in spring and summer months throughout the study area (Boran et al. 1979). Spring is the period when migrants moving north may wander into Puget Sound and the numbers of regularly occurring species increase, perhaps in response to increasing productivity.

Of the 15 species of cetaceans reported in the study area, only 5 (gray whale, minke whale, killer whale, harbor porpoise, and Dall's porpoise) can be considered common. The remaining 10 species are considered either rare (3) or accidental (7) and are not expected to occur in the study area with any regularity or predictability.

Table 14 summarizes the seasonal distribution and relative abundance of the commonly occurring cetaceans in the study area by geographical region. Abundance for all species begins to increase in spring to maximum numbers in summer and then declines in fall. The exception to this general observation is the gray whale, which is most abundant in the inland waters (though in small numbers) during its late fall and early spring migrations south and north, respectively. Pooled data on gray whales from this study and aerial surveys conducted on the outer Washington coast (Everitt and Jeffries 1979) demonstrate the seasonal abundance of these migratory animals in Washington waters (Figure 13).

The deficiencies of the present cetacean data, which rely heavily on reports from the public (biased towards maximum recreational months) have been discussed in other reports (Boran and Osborne 1978; Everitt et al. 1979; Boran et al. 1979). Presently, the absence of a species from any

TABLE 14.--Occurrence of cetaceans described as common in the study area by geographical regions during the four seasons of the year. 0 = species present, + = greatest abundance, - = not present or known to occur.

	Location					
	Juan de Fuca					
Species	(West) I	(East) II	Haro Strait III	Rosario Strait IV	Eastern bays V	Season
Gray whale (Eschrichtius robustus)	+	0	-	0	0	Sp
	+	0	-	0	0	Su
	+	0	-	0	0	F
	0	0	-	-	0	W
Minke whale (Balaneoptera acutorostrata)	0	+	+	+	+	Sp
	0	+	+	+	+	Su
	-	0	+	0	0	F
	-	0	+	0	0	W
Killer whale (Orcinus orca)	+	+	+	+	0	Sp
	+	+	+	+	0	Su
	0	+	+	+	0	F
	0	0	+	0	0	W
Harbor porpoise (Phocoena phocoena)	0	+	+	0	+	Sp
	0	0	+	+	+	Su
	0	0	+	0	0	F
	-	0	0	0	0	W
Dall's Porpoise (Phocoenoides dalli)	0	+	0	0	0	Sp
	+	+	+	0	0	Su
	+	0	0	0	0	F
	0	0	-	-	-	W

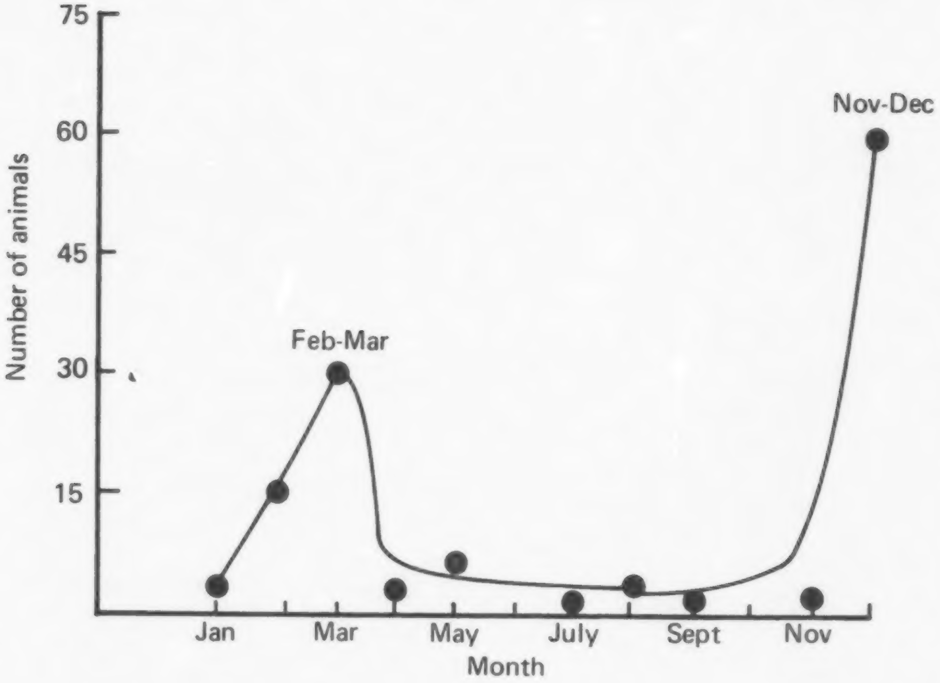


Figure 13. Highest monthly counts of gray whales in Puget Sound, the San Juan Islands, the Strait of Juan de Fuca, and Washington coastal waters, 1976-79.

area is considered tentative until such time as increased effort information can verify that absence. Absence from an area may simply indicate lack of data.

An attempt to show the relative importance of each geographical region by season can be made by subjectively assigning numerical values to the data in Table 14. A value of 5 is assigned to regions where a species occurs in greatest abundance, 3 is given to regions where a species is considered present but not particularly abundant, and 1 is given to regions where a species is not known to occur (a 1 is used rather than a zero since absolute absence from an area cannot conclusively be demonstrated) (Table 15). Tallying these numbers for each species by region and by season provides a "score" which for the purposes of this report indicates the relative importance of the season or region to cetaceans; the higher the score the greater the importance to cetaceans.

Considering that little is known concerning behavioral responses to disturbance, physiological effects of oil, and actual abundance of cetaceans, a numerical ranking of these areas may seem somewhat futile, but such an exercise does flag areas as being potentially sensitive for cetaceans. The eastern Strait of Juan de Fuca, Region II, obtained the highest rank for all seasons, perhaps due to its central location in the study area (most species entering and leaving the study area must pass through it) and productive banks (e.g., Partridge, Hein, and Middle Banks), it also ranks highest in the spring season over the other regions and seasons. All regions ranked high for the spring and summer months, thus time of greatest vulnerability for cetaceans is probably in late spring and summer when more species occur in the study area. For some of the cetaceans reproductive activity (breeding, calving, suckling) occurs during spring and summer in these waters.

Mustelids

The only mustelid considered in this project, the river otter, is locally abundant in all portions of the study area throughout the year, and a certain portion of the population in the San Juan Islands utilizes the marine waterways to move from island to island. Seasonal migrations of large numbers of river otters are not known to occur and there are no estimates of their numbers in the study area. Other small mammals that occasionally feed in the intertidal areas but are never completely marine (e.g., mink (Mustela vison) were not considered in the study. The sea otter (Enhydra lutris), often confused with river otters, does not occur in the study area.

The river otter is particularly vulnerable to oil development during all seasons in two important ways: (1) habitat loss through increased shoreline development, and (2) contact with spilled oil which would cause hypothermia, probably leading to death. A large scale oil spill could effectively eliminate this species from the impacted area.

TABLE 15.--Relative importance of geographical regions in the study area to cetaceans. Numerical values are based on Table 16 (+ = 5; 0 = 3; - = 1).

Area	Season Spring	 Summer	 Fall	 Winter	All seasons
Strait of Juan de Fuca					
West I	19	21	17	11	68
East II	23	21	17	15	76
San Juan Islands					
Haro Strait III	19	21	19	15	74
Rosario Strait IV	19	21	17	11	68
Eastern bays-protected waters V	19	19	15	13	66
Total by season	99	103	85	65	

Pinnipeds

The pinnipeds (families Otariidae and Phocidae) are represented in the study area by five species. Two of these are rare, the fur seal occurring in low numbers primarily during winter and spring, and the elephant seal in spring, summer, and fall. Another two species, the California sea lion and northern sea lion, are seasonally abundant in late fall, winter, and early spring. One species, the Pacific harbor seal, is a year-round resident and the only pinniped that breeds in these waters.

The northern fur seal may wander into the western Strait of Juan de Fuca in the fall and winter months. Actual numbers are not known but are expected to be low since this species is most abundant offshore. Occurrences of fur seals in Haro Strait, Rosario Strait, and Puget Sound are rare. Fouling of the hair and fur of a northern fur seal with oil would probably prove fatal. The limited appearance of this species in local waters precludes any serious damage to this stock related to development of oil activities in Washington waters.

The elephant seal occurs in insignificant numbers in the study area. Primary periods of occurrence are spring to fall. This species can probably be found most often in the Strait of Juan de Fuca, though records exist for all areas. The large number of sightings from Admiralty Inlet probably reflects the high density of small boats in that region and not the relative abundance of elephant seals. Impact to these scattered individuals from an oil spill is expected to be minimal. No rookeries are located in Washington and thus no breeding habitat would be impacted.

The two species of sea lions (California sea lion and northern sea lion) occur in the study area simultaneously with both species being most abundant in the eastern Strait of Juan de Fuca. Northern sea lions begin arriving in the study area during post-breeding season movements of animals off their breeding rookeries in other states or British Columbia and offshore Washington haul sites in the fall. Both sexes of northern sea lions can be found here although no breeding activity has been documented in Washington. California sea lions (presumably all males) which have come north from their California breeding rookeries, occur in Rosario Strait and Haro Strait in limited numbers. A small hauling site is known at Dodd Narrows near Nanaimo, on Vancouver Island British Columbia (Bigg 1973a) and recently one was identified in Port Gardner, Washington. Northern sea lions haul out regularly at several sites in the inside waters of Washington. Their abundance in the study area is low though usually greater than that of California sea lions. More animals of both species are found in the eastern Strait than in other inside waters.

Both northern and California sea lions haul out regularly in season on Race Rocks and to a lesser degree at Sombrio Point off southeast Vancouver Island. After a late spring and summer absence both species first appear at these sites by October. The maximum counts of California sea lions were taken in December 1977 of 76 animals and in May 1979 of 108. The number fluctuated at slightly lower levels during January through April, rapidly declining by the end of May. No California sea lions were sighted in the study area in June. An unusually large number (108) appeared at Port Gardner in May 1979, perhaps in response to locally abundant food resources. Pacific whiting (hake) otoliths appeared most frequently in scat collected from the Port Gardner hauling site. In November 1979, nearly 300 California sea lions were counted at Race Rocks from the NOAA research vessel John N. Cobb. The significance of this count, which is much larger than previous counts, is unclear but may indicate increasing early seasonal use of the study area by this species.

Northern sea lions are most abundant from December through March. Counts for December, January, and March 1977-1979 were about 200 animals. Lower counts were obtained in February 1978 and 1979 primarily because foul weather limited complete survey coverage. A rapid decline in the number of northern sea lions was observed in May, and by June no northern sea lions remained on the hauling sites.

The seasonal abundance of sea lions in the study area during 1977-79 is shown in Figure 14. Sea lions would be most vulnerable to oil activities in winter, primarily in the eastern Strait of Juan de Fuca (Region II). The effect of an oil spill on either species is not completely known; however, there are no breeding sites in the study area.

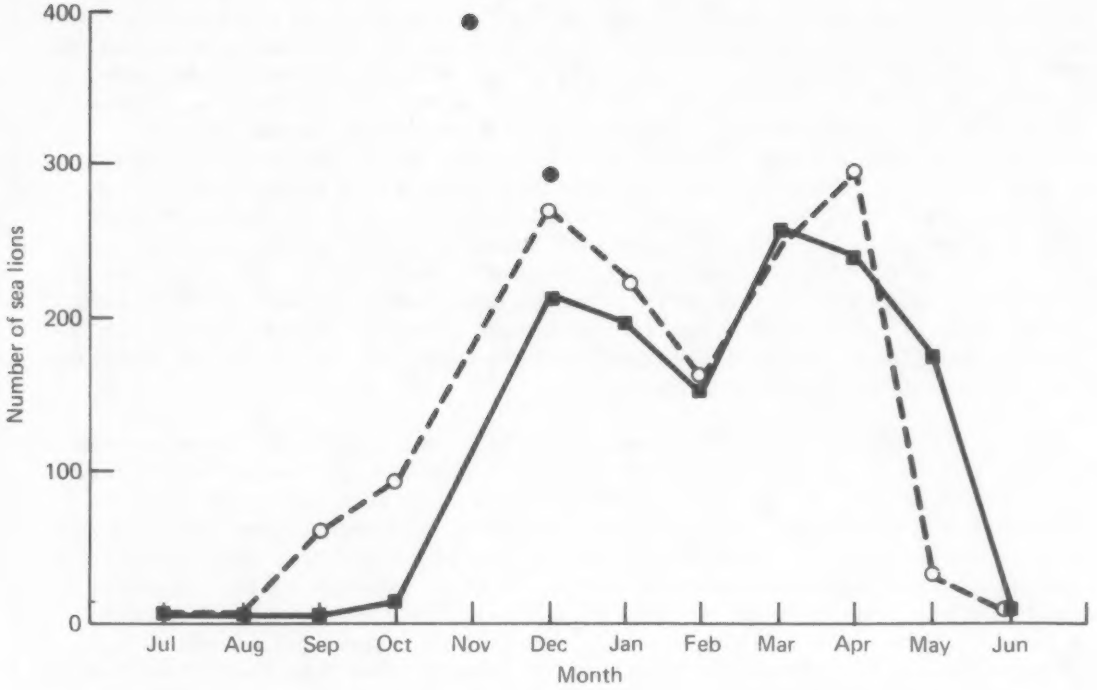


Figure 14. Seasonal abundance of northern and California sea lions in the study area, 1977-1979, 1977-78(--) 1978-79(—), except Nov and Dec 1979 counts which are shown as circles ●.

The harbor seal is abundant in the study area throughout the year. Pupping begins first at Minor Island in late June and lasts about eleven weeks, ending in early September. Pupping peaks during the month of August. Important breeding sites are centered in the eastern Strait of Juan de Fuca (Region II) at Minor Island, Protection Island, and Dungeness Wildlife Refuge, and account for at least 42% of the total productivity for the study area. The San Juan Islands and Rosario Strait (Region IV) rank next in importance as pupping areas accounting for a minimum productivity of about 30% in 1978.

The abundance of adults and immatures in the study area varies seasonally; it could not be determined if these differences were the result of deficiencies in survey methodology or represent actual movements of animals. A preliminary tagging study on Protection Island suggested that there may be little exchange of animals between rookeries in the summer months. Differences in the frequency of occurrence of fish otoliths in harbor seal scat from Protection Island suggests opportunistic feeding on seasonally abundant prey species. Seasonal movements of large numbers of harbor seals in response (perhaps) to changing abundances of prey species has been suggested on the outer coast and to a lesser extent in the western Strait of Juan de Fuca (Region I) (Everitt and Jeffries 1979). Table 16 lists the relative seasonal abundance of harbor seals (generally in descending order) as a percentage of the total number counted during aerial surveys. The eastern Strait of Juan de Fuca (Region II) contains the largest percentage of the population for any season. The numbers decreased there in fall and winter corresponding to an increase in outlying areas, particularly the western Strait of Juan de Fuca (Region I) and Haro Strait (Region III). The high count for the study area, taken in August 1979, was over 2,000 harbor seals.

The relative abundance of pinnipeds found regularly in the study area is shown in Table 17. It is clear that the eastern Strait of Juan de Fuca is the most significant region (in terms of numbers) during all seasons of the year and is particularly vulnerable during the summer reproductive period for harbor seals.

The harbor seal tends to dominate other marine mammals of the study area, in terms of available knowledge, accessibility for study, and actual abundance. This species warrants continued monitoring as development of the Puget Sound area increases.

Table 16.--Seasonal variations of the harbor seal population in the five regions of the study area expressed as a percent of total population.

Regions	Season Winter	 Spring	 Summer	 Fall
Eastern Strait of Juan de Fuca (II)	59.9	44.4	43.1	31.6
Haro Strait (III)	19.6	31.3	21.1	22.4
Rosario Strait (IV)	8.3	16.0	23.8	26.6
Eastern Bays (V)	4.0	5.2	10.0	12.3
Western Strait of Juan de Fuca (I)	8.2	3.1	2.0	7.1
TOTAL	100.0	100.0	100.0	100.0

Table 17.--Occurrence of pinnipeds described as common in the study area by geographical regions during the four seasons of the year. 0 = species present, + = greatest abundance, - = not present or known to occur.

Species	Location					Season
	Juan de Fuca (West) I	Juan de Fuca (East) II	Haro Strait III	Rosario Strait IV	Eastern Bays V	
California sea lion (*Zalophus c. californianus*)	-	-	-	-	-	Spring
	-	-	-	-	-	Summer
	0	0	0	-	-	Fall
	+	+	+	0	0	Winter
Northern sea lion (*Eumetopias jubatus*)	-	-	-	-	-	Spring
	-	-	-	-	-	Summer
	0	0	0	-	-	Fall
	+	+	+	0	0	Winter
Harbor seal (*Phoca vitulina richardsi*)	+	+	+	+	+	Spring
	+	+	+	+	+	Summer
	+	+	+	+	+	Fall
	+	+	+	+	+	Winter

REFERENCES[1]

Ainley, D.G., H.R. Huber, R.P. Henderson, T.J. Lewis, and S.H. Morrell. 1977. Studies of marine mammals at the Farallon Islands, California, 1975-76. Final report for MMC contract MM5AC020. Mar. Mammal Comm., Washington, D.C., 32 p.

Antonelis, G.A., and C.H. Fiscus. 1980. The pinnipeds of the California Current. Calif. Coop. Oceanic Fish. Invest., CALCOFI Rep. 21:68-78.

Asper, E.D., and L.H. Cornell. 1977. Live capture statistics for the killer whale (*Orcinus orca*) 1961-1976 in California, Washington, and British Columbia. Aquat. Mammal. 5(1):21-26.

Balcomb, K.C. 1973. Cuvier's beaked whale from Washington State. Murrelet 54:37.

Balcomb, K.C., J.R. Boren, R.W. Osborne, and N.J. Haenel. 1979a. Observations of Killer Whales (*Orcinus orca*) in Greater Puget Sound, State of Washington; A report of field research conducted by the Moclips Cetological Society, Inc. 1 April, 1976, through 31 December, 1978. Moclips Cetological Society, Friday Harbor, Wash. Sept. 1979. 27 p. and 17 plates.

Balcomb, K.C., J.R. Boren, and R.W. Osborne. 1979b. Killer Whales (*Orcinus orca*) in Greater Puget Sound. p. 1. Abstracts from presentations of the Third Biennial Conference of the Biology of Marine Mammals. Seattle, Wash. Oct. 1979.

Bartholomew, G.A. 1967. Seal and sea lion populations of the California Islands. *In*: R.N. Philbrick (editor), Proc. Symp. on the Biology of the California Islands, p. 229-244. Santa Barbara Botanic Gardens, California.

---

[1] Everitt et al. (1979) include in their bibliography many references not specifically cited in the text but useful in the study of marine mammals of Washington and adjacent waters; however, that report does not contain a complete bibliography of the marine mammal literature of Washington. In this report we list only those references cited in the text and refer the reader to Everitt et al. (1979) for additional references.

Bigg, M.A. 1969a. Clines in the pupping of harbour seal, Phoca vitulina. J. Fish. Res. Board Can. 26:449-455.

Bigg, M.A. 1969b. The harbour seal in British Columbia. Fish. Res. Board Can., Bull. 172, 31 p.

Bigg, M.A. 1973a. Census of California sea lions on southern Vancouver Island, British Columbia. J. Mammal. 54:285-287.

Bigg, M.A. 1973b. Adaptations in the Breeding of the Harbour Seal, Phoca vitulina. J. Reprod. Fert., Suppl. 19:131-142.

Bigg, M.A. 1979. Interaction between pods of killer whales off British Columbia and Washington. p. 3. Abstracts from presentations at the Third Biennial conference of the Biology of Marine Mammals. Seattle, Wash. Oct. 1979.

Bigg, M.A., and H.D. Fisher. 1975. Effect of photoperiod on annual reproduction in female harbor seals. Rapp. P.-V. Réun. Cons. Int. Explor. Mer. 169:141-144.

Bigg, M.A., and A.A. Wolman. 1975. Live-Capture killer whale (Orcinus orca) fishery, British Columbia and Washington, 1962-73. J. Fish. Res. Board Can. 32:1213-1221.

Bishop, R.H. 1967. Reproduction, age determination and behavior of the harbor seal, Phoca vitulina L., in the Gulf of Alaska. M.S. Thesis, Univ. of Alaska, College, Alaska, 121 p.

Boran, J.R., and R.W. Osborne. 1978. Orca Survey: whale hotline cetacean sightings report. Contract report (01-78-MO2-01198) to Marine Mammal Div., Nat. Mar. Fish. Serv., Seattle, Wash. 50 p.

Boran, J.R., N.S. Haenel, and S.L. Heimlich. 1979. Cetacean sighting report, October 1978 - October 1979. Report (ABD-0013) Natl. Marine Mammal Lab., Natl. Mar. Fish. Serv., Seattle, Wash. 29 p.

Boulva, J. 1975. Temporal variations in birth period and characteristics of newborn harbor seals. Rapp. P-V Reun. Cons. Int. Explor. Mer. 169:405-408.

Braham, H.W., R.D. Everitt, and D.J. Rugh. 1980. Northern sea lion population decline in the eastern Aleutian Islands, Alaska. J. Wildl. Manage. 44:25-33.

Brown, R.F.,and B.R. Mate. 1979. Movements of tagged harbor seals, Phoca vitulina, between two adjacent Oregon estuaries (Netarts and Tillamook Bays). p. 4. Abstracts from presentations at the Third Biennial Conference of the Biology of Marine Mammals. Seattle, Wash. Oct. 1979.

Calambokidis, J., K. Bowman, S. Carter, J. Cubbage, P. Dawson, T. Fleischner, J. Schuett-Hames, J. Skidmore, and B. Taylor. 1978. Chlorinated hydrocarbon concentrations and the ecology and behavior of harbor seals in Washington State waters. Evergreen State College, Olympia, Wash., 121 p.

Calambokidis, J.A., R.D. Everitt, J.C. Cubbage, and S.D. Carter. 1979. Harbor seal census for the inland waters of Washington. Murrelet 60:110-112.

Calkins, D.G., and K.W. Pitcher. 1977. Unusual sightings of marine mammals in the Gulf of Alaska. Abstract Proceedings of the Second Conference on the Biology of Marine Mammals, San Diego, Calif.

Cornell, L.H., and E.D. Asper. 1976. A census of captive marine mammals in North America. Food and Agric. Organ. U.N., Adv. Comm. Mar. Resource Res., FAO ACMRR/MM/SC90, 90 p.

Cowan, I.M. 1944. The Dall Porpoise, Phocoenoides dalli (True), of the Northern Pacific Ocean. J. Mammal 25:295-306.

Cowan, I.M., and G.C. Carl. 1945. The northern elephant seal (Mirounga angustirostris) in British Columbia waters and vicinity. Can. Field-Nat. 59:170-171.

Cowan, I.M., and C.J. Guiguet. 1952. Three cetacean records from British Columbia. Murrelet 33:10-11.

Cowan, I.M., and C.J. Guiguet. 1965. The Mammals of British Columbia. British Columbia Prov. Mus., Dept. Cons. Handbook No. 11, 414 p

Craddock, D.R. 1969. Northern elephant seal sighted in Puget Sound, Washington. Murrelet 50:37.

Cross, J.N., K.L. Fresh, B.S. Miller, C.A. Simenstad, S.N. Steinfort, and J.C. Figley. 1978. Nearshore fish and macroinvertebrate assemblages along the Strait of Juan de Fuca including food habits of the common nearshore fish. U.S. Dep. Commer., NOAA Tech. Memo. ERL MESA-32. Environ. Res. Lab., Boulder, Colo., 188 p.

DeLong, R.L. 1978. Northern elephant seal. In Delphine Haley (editor), Marine mammals of eastern North Pacific and Arctic waters, p. 206-211. Pacific Search Press, Seattle, Wash.

Drager, R.G. 1977. Using otoliths from the feces of harbor seals as a method of diet sampling. Undergraduate project, Oregon State Univ., Corvallis, 9 p.

Eberhart, L.L., D.G. Chapman, and J.R. Gilbert. 1979. A Review of Marine Mammal Census Methods. Wildlife Monog. 63, 46 p.

Everitt, R.D. 1980. Populations of harbor seals and other marine mammals: northern Puget Sound. M. S. Thesis, Univ. Washington, Seattle., 283 p.

Everitt, R.D., C.H. Fiscus, and R.L. DeLong. 1979. Marine mammals of northern Puget Sound and the Strait of Juan de Fuca: a report on investigations November 1, 1977 to October 31, 1978. U.S. Dep. Commer., NOAA Tech. Memo. ERL MESA-41. Environ. Res. Lab., Boulder, Colo., Jan. 1979., 191 p.

Everitt, R.D., and S.J. Jeffries. 1979. Marine mammal investigations in Washington State. p. 18. Abstracts from presentations of the Third Biennial Conference of the Biology of Marine Mammals. Seattle, Wash., Oct. 1979.

Fiscus, C.H., and G.A. Baines. 1966. Food and feeding behavior of Steller and California sea lions. J. Mammal. 47:195-200.

Fiscus, C.H., and H. Kajimura. 1965. Puget Sound whaling cruise, 1-14 July 1965. U.S. Dep. Commer., Natl. Oceanic Atmos. Admin., Natl. Mar. Fish. Serv., Natl. Mar. Mammal Lab., Seattle, Wash., 17 p.

Fiscus, C.H., K. Niggol, and F. Wilke. 1961. Pelagic fur seal investigations, California to British Columbia, 1961. U.S. Dep. Commer., Natl. Oceanic Atmos. Admin., Natl. Mar. Fish. Serv., Natl. Mar. Mammal Lab. Seattle, Wash., 87 p.

Fiscus, C.H., H.W. Braham, R.W. Mercer, R.D. Everitt, B.D. Krogman, P.D. McGuire, C.E. Peterson, R.M. Sonntag, and D.E. Withrow. 1977. Seasonal distribution and relative abundance of marine mammals in the Gulf of Alaska. Environmental assessment of the Alaskan Continental Shelf. p. 19-264. Vol. 1. Principal investigators reports for October - December 1976. U.S. Dep. Commer., Natl. Oceanic Atmos. Admin., Environ. Res. Lab., Boulder, Colo. 831 p.

Fisher, H.D. 1952. The status of the harbor seal in British Columbia, with particular reference to the Skeena River. Fish. Res. Board. Can., Bull 93, 58 p.

Fitch, J.E., and R.L. Brownell, Jr. 1968. Fish otoliths in cetacean stomachs and their importance in interpreting feeding habits. J. Fish. Res. Board Can. 25:2561-2574.

Geraci, J.R., and D.J. St.Aubin. 1979. Possible effects of offshore oil and gas development on marine mammals: Present status and research recommendations. Marine Mammal Commission, Washington, D.C. 37 p.

Green, K.A. In press. Ecosystem description of the California Current. Final report for MMC contract MM7AC-006, Marine Mammal Commission, Washington, D.C. 73 p.

Guiguet, C.J. 1954. A record of Baird's dolphin (_Delphinus_ _bairdi_ Dall) in British Columbia. Can. Field-Nat. 68:136.

Hancock, D. 1965. Killer whales kill and eat minke whale. J. Mammal. 46:341-342.

Hatler, D.G., and J.D. Darling. 1974. Recent observations of the gray whale in British Columbia. Can. Field-Nat. 88:449-459.

Henderson, D.A. 1972. Men and whales at Scammons Lagoon. Dawson's Book Shop, Los Angeles, Calif., 313 p.

Hirschi, R. 1978. Western Washington river otters. Rep., Wash. Dep. Game, Olympia. June 1978. 12 p.

Imler, R.H., and H.R. Sarber. 1947. Harbor seals and sea lions in Alaska. U.S. Fish Wildl. Serv., Spec. Sc. Rep. 28, 23 p.

Jameson, R.J. 1977. The status of translocated sea otters in the eastern Pacific Ocean. p. 8. Proceedings (Abstracts), Second Conference of the Biology of Marine Mammals. San Diego, Calif., Dec. 1977.

Johnson, B.W., and P.A. Johnson. 1979. Population peaks during the molt in harbor seals. p. 31. Abstracts from presentations at the Third Biennial Conference of the Biology of Marine Mammals. Seattle, Wash., Oct. 1979., 64 p.

Johnson, M.L., and S.J. Jeffries. 1977. Population evaluation of the harbor seals (_Phoca_ _vitulina_ _richardi_) in the waters of the State of Washington. Final report for MMC Contract MM5AC019. Natl. Tech. Info. Serv. Catalogue No. PB-270376., 27 p.

Jones, L.L., T.C. Newby, T.W. Crawford, and S. Treacy. 1980. Progress report on life history studies of Dall's porpoise in the northwestern Pacific, 1978-1979. INPFC Doc. 2269. Doc. submitted to meeting of the Scientific Subcommittee on Marine Mammals, International North Pacific Fisheries Commission Tokyo, Japan, Feb. 1980., 34 p.

Kenyon, K.W. 1965. Food habits of harbor seals at Amchitka Island, Alaska. J. Mammal 46:103-104.

Kenyon, K.W. 1969. The sea otter in the eastern Pacific ocean. U.S. Fish. Wildl. Serv., North Am. Fauna 68, 352 p.

Kenyon, K.W., and D.W. Rice. 1961. Abundance and distribution of the Steller sea lion. J. Mammal. 42:223-234.

Kenyon, K.W., and V.B. Scheffer. 1962. Wildlife surveys along the northwest coast of Washington. Murrelet 42:29-37.

Kooyman, G.L., R.L. Gentry, and W.B. McAlister. 1977. Physiological impact of oil on pinnipeds. Environmental assessment of the Alaskan continental shelf. Principal Investigators' Reports. October-December 1976, p. 3-26. Vol. 2. Receptors (Biota) - fish, plankton, benthos, littoral. U.S. Dep. Commer. Natl. Oceanic Atmos. Admin., Environ. Res. Lab., Boulder, Colo.

Le Boeuf, B.J., M.L. Bonnell, M.O. Pierson, D.H. Dettman, and B.D. Farrens. 1976. Pinnipedia numbers distribution and movements in the southern California bight. In Regents of the University of California (editor), Section 1., p. 1-269. Marine mammal and seabird survey of the southern California bight area, Vol. III.

Le Boeuf, B.J., and M.L. Bonnell. 1978. Pinnipeds of the California Islands, abundance and distribution. Proc. Santa Barbara Mus. Nat. Hist. Feb. 27-Mar. 1, 1978., 27 p.

Lemberg, N.A. 1978. Hydroacoustic Assessment of Pudget Sound Herring, 1972-1978. Wash. Dep. Fish., Tech. Rep. 41, 43 p.

Manuwal, D.A., T.R. Wahl, and S.M. Speich. 1979. Seasonal distribution and abundance of marine bird populations in the Strait of Juan de Fuca and northern Puget Sound in 1978. U.S. Dep. Commer., NOAA Tech. Memo. ERL MESA-44. Env. Res. Lab., Boulder, Colo., 391 p.

Mate, B.R. 1975. Annual migrations of the sea lions Eumetopias jubatus and Zalophus californianus along the Oregon coast. Rapp. P-V Rèun. Cons. Int. Explor. Mer. 169:455-461.

Mate, B.R. 1977. Aerial censusing of pinnipeds in the eastern Pacific for assessment of the population numbers, migratory distributions, rookerey stability, breeding effort, and recruitment. Final report for MMC contract MM5AC001. Natl. Tech. Info. Serv. Catalogue No. Pub. PB-265859, 67 p.

Mitchell, E. 1968. Northeast Pacific stranding distribution and seasonality of Cuvier's beaked whale Ziphius cavirostris. Can. J. Zool. 46:265-279.

Moore, J.C. 1966. Diagnosis and distributions of beaked whales of the Genus Mesoplodon known from North American waters. In K.S. Norris, (editor), Whales, dolphins, and porpoises, p. 32-61. Univ. of California Press, 789 p.

National Marine Fisheries Service. 1978. Current status of stocks of marine mammals. In Annual Report. The Marine Mammal Protection Act of 1972. p. 37-183. U.S. Dep. Commer., Washington, D.C. April 1, 1977 to March 31, 1978. 203 p.

National Marine Fisheries Service. 1979. Current status of stocks of marine mammals. In Annual Report. The Marine Mammal Protection Act of 1972. p. 29-57. U.S. Dep. Commer., Washington, D.C. April 1, 1978 to March 31, 1979.

National Marine Fisheries Service. 1980. A report based on the workshop on stock assessment and incidental take of marine mammals involved in commercial fishing operations. U.S. Dep. Commer., Natl. Oceanic Atmos. Admin., Natl. Mar. Fish. Serv., Natl. Mar. Mammal Lab., Seattle, Wash. 101 p.

Nemoto, T. 1959. Food of baleen whales with reference to whale movements. Sci. Rep. Whales Res. Inst. 14:149-290.

Newby, T.C. 1971. Distribution, population dynamics, and ecology of the harbor seal, Phoca vitulina richardii, of the southern Puget Sound, Washington. M.S. Thesis. Univ. Puget Sound, Tacoma, Wash., 75 p.

Newby, T.C. 1973a. Changes in the Washington State harbor seal population, 1942-1972. Murrelet 54:4-6.

Newby, T.C. 1973b. Observations on the breeding behavior of the harbor seal in the State of Washington. J. Mammal. 54:540-543.

Omura, H, and H. Sakiura. 1956. Studies on the little piked whale from the coast of Japan. Sci. Rep. Whales Res. Inst. 11:1-37.

Orr, R.T. 1951. Cetacean records from the Pacific Coast of North America. Wasmann J. Biol. 9:147-148.

Pearson, J.P., and B.J. Verts. 1970. Abundance and distribution of harbor seals and northern sea lions in Oregon. Murrelet 51:1-5.

Pike, G.C., and I.B. MacAskie. 1969. Marine mammals of British Columbia. Fish. Res. Board. Can. Bull. 171, 54 p.

Pitcher, K.W. 1977. Population productivity and food habits of harbor seals in the Prince William Sound-Copper River Delta area, Alaska. Final report for MMC contract MM5AC011. Natl. Tech. Info. Serv. Catalogue No. PB-266-935, 36 p.

Pitcher, K.,and D. Calkins. 1977. Biology of the harbor seal, Phoca vitulina richardi, in the Gulf of Alaska. Environmental Assessment of the Alaskan Continental Shelf. Annual reports of principal investigators for the year ending March 1977, p. 189-225. Vol. 1. Receptors Mammals. U.S. Dep. Commer., Natl. Oceanic Atmos. Admin., Environ. Res. Lab., Boulder, Colo., 708 p.

Pitcher K., and D. Calkins. In press. Biology of the harbor seal Phoca vitulina richardi, in the Gulf of Alaska. Final Report, RU 229. In Environmental Assessment of the Alaskan Continenal Shelf. Annual reports of principal investigators. U.S. Dep. Commer., Natl. Oceanic Atmos. Admin., Environ. Res. Lab., Boulder, Colo., 72 p.

Rice, D.W. 1968. Stomach contents and feeding behavior of killer whales in the eastern North Pacific. Norsk. Hvalfangst.-Tidende 3:35-38.

Rice, D.W. 1977. A list of the marine mammals of the world. U.S. Dep. Commer., NOAA Tech. Rep. NMFS SSRF-711., 15 p.

Rice, D.W., and A.A. Wolman. 1971. The life history and ecology of the gray whale (*Eschrichtius robustus*). Am. Soc. of Mammal., Spec. Pub. 3., 142 p.

Rugh, D.J., and H.W. Braham. 1979. California Gray Whale (*Eschrichtius robustus*) fall migration through Unimak Pass, Alaska, 1977. A preliminary Report. Rep. Int. Whale Comm. 29, p. 315-320.

Scattergood, L.W. 1949. Notes on the little piked whale (with bibliography). Murrelet 30:3-16.

Scheffer, T.H., and T.C. Sperry. 1931. Food habits of the Pacific harbor seal, *Phoca vitulina richardi*. J. Mammal 12:214-226.

Scheffer, V.B. 1953. Measurements and stomach contents of eleven delphinids from the northeast Pacific. Murrelet 34:27-30.

Scheffer, V.B. 1978. False Killer Whale. *In* Delphine Haley (editor), Marine mammals of eastern North Pacific and Arctic waters, p. 128-131. Pac. Search Press, Seattle, Wash.

Scheffer, V.B., and K.W. Kenyon. 1963. Elephant seal in Puget Sound, Washington. Murrelet 44:23-24.

Scheffer, V.B., and J.W. Slipp. 1944. The harbor seal in Washington State. Am. Midl. Nat. 32:373-416.

Scheffer, V.B., and J.W. Slipp. 1948. The whales and dolphins of Washington State with a key to the cetaceans of the west coast of North America. Am. Midl. Nat. 39:257-337.

Scientific Event Alert Network. 1979. Marine mammal strandings and sightings. Natl. Mus. Nat. Hist., Washington, D.C., SEAN Bull. 4(6):19-24.

Seattle Post Intelligencer, 27 May 1970.

Shaughnessy, P.D., and P.H. Fay. 1977. A review of the taxonomy and nomenclature of North Pacific harbor seals. J. Zool., Lond. 182: 385-419.

Simenstad, C.A., B.S. Miller, C.F. Nyblade, K. Thornburgh, and L.J. Bledsoe. 1979. Food web relationships of northern Puget Sound and the Strait of Juan de Fuca, a synthesis of the available knowledge. U.S. Environ. Prot. Agency, Off. Res. Dev. Interagency Energy-Environ. Res. Dev. Ser., EPA-600/7-79-259, 335 p.

Slipp, J.W., and F. Wilke. 1953. The beaked whale Berardius on the Washington coast. J. Mammal. 34:105-113.

Smith, I.D. 1972. Sea lions wintering along the outer coast of Vancouver Island. J. Fish. Res. Board Can. 29:1764-1766.

Spaulding, D.J. 1964. Comparative feeding habits of the fur seal, sea lion, and harbor seal on the British Columbia Coast. Fish. Res. Board Can., Bull. 146. 52 p.

Stroud, R.K. 1968. Risso dolphin in Washington State. J. Mammal. 49:347-348.

Stroud, R.K., C.H. Ficus, and H. Kajimura. In Press. Food of the Pacific white-sided dolphin (Lagenorhynchus obliquidens), Dall's porpoise (Phocoenoides dalli) and northern fur seal (Callorhinus ursinus), off California and Washington. Fish. Bull., U.S. 74(4).

Stutz, S.S. 1967a. Pelage patterns and population distributions in the Pacific harbor seal (Phoca vitulina richardi). J. Fish. Res. Board Can. 24:451-455.

Stutz, S.S. 1967b. Moult in the Pacific harbor seal, Phoca vitulina richardsi. J. Fish. Res. Board Can. 24:435-441.

Summers, C. and M. Mountfield. 1975. Counting the common seal. Nature 253:670-671.

Venables, V.M., and L.S.V. Venables. 1955. Observations on a breeding colony of the seal Phoca vitulina in Shetland. Proc. Zool. Soc. London, 125:521-532.

Wahl, T.R. 1977. Sight records of some marine mammals offshore from Westport, Washington. Murrelet 58:21-23.

Wilke, F. 1957. Food of sea otters and harbor seals at Amchitka Island. J. Wildl. Mam. 21:241-242.

Wilke, F., and C.H. Fiscus. 1961. Gray whale observations. J. Mammal 42:108-109.

Wilke, F. and K.W. Kenyon. 1952. Notes on food of fur seal, sea lion, and harbor porpoise. J. Wildl. Manage. 16:396-397.

Wilson, S.C. 1973. Juvenile play of the common seal *Phoca vitulina* with comparative notes on the gray seal *Halichoerus grypus*. Behavior 48:37-60.

Wolman, A.A. 1978. Humpback whale. p. 46-53. *In* D. Haley (editor), Marine Mammals. Pac. Search Press, Seattle, Wash.

APPENDIX A

Records of marine mammals, sighted in northern Puget Sound, the San Juan Islands, the eastern bays, and the Strait of Juan de Fuca, 1978-79. Sighting records and reports prior to October 1978 for some species can be found in the individual species accounts in Everitt et al. 1979.

The numbers of harbor seals sighted during aerial surveys from December 1978 through August 1979 are given in Appendix A, Tables A-2 - A-7, and the location of haul sites are shown in Appendix A, Figures A-1 and A-2.

Table A-1.--Numbers of northern sea lions, California sea lions, and sea lions (species undetermined) at Race Rocks, British Columbia from December 1978 to December 1979. Counts from aerial photographs except October to December 1979 from vessel.

Year day/month	Northern sea lion	California sea lion	Species undetermined sea lion	Total sea lion
1978				
27 December	150	33	8	191
28 December	94	54	2	150
1979				
18 January	123	62	15	200
31 January	133	10	4	147
16 February	134	15	3	152
19 March	207	38	3	248
20 March	187	47	14	248
17 April	212	24	0	236
26 April	190	16	10	216
16 May	66	0	0	66
22 May	1	0	0	1
21 June	0	0	0	0
9 July	0	0	0	0
8 August	0	0	0	0
7 September	0	0	0	0
23 October	10	25	0	35
6 November	100	296	0	396
4 December	152	144	0	296

Table A-2.--Numbers of harbor seals sighted on aerial surveys of the islands, islets, and rocks of the San Juan Wilderness area, December 1978 through May 1979. - = locality not surveyed, 0 = no animals present. Map reference numbers refer to Figure A-1.

Map reference number	1978		1979								
	Dec 27	Dec 28	Jan 18	Jan 31	Feb 16	Mar 19	Mar 20	Apr 17	Apr 26	May 22	May 23
1. Small I.	-	-	-	0	-	0	-	-	0	-	10
2. Unnamed I.	0	-	-	0	-	0	-	-	0	-	0
3. Fortress I.	0	-	-	0	-	0	-	-	0	-	0
4. Skull I.	0	-	-	0	-	0	-	-	0	-	0
5. Crab I.	0	-	-	0	-	0	-	-	0	-	0
6. Boulder I.	0	-	-	0	-	0	-	-	0	-	0
7. Davidson Rock	0	-	-	0	-	0	-	-	0	-	0
8. Castle I.	0	-	-	0	-	0	-	-	0	-	0
9. Unnamed I.	0	-	-	0	-	0	-	-	0	-	0
10. Aleck Rocks	0	-	-	0	-	0	-	-	0	-	0
11. Swirl I.	0	-	-	0	-	0	-	-	0	-	0
12. Unnamed Rock	0	-	-	0	-	0	-	-	0	-	0
13. Unnamed Is.	0	-	-	0	-	0	-	-	0	-	0
14. Unnamed Is.	0	-	-	0	-	0	-	-	0	-	0
15. Hall I.	0	-	-	0	-	0	-	-	0	-	0
16. Unnamed I.	0	-	-	0	-	0	-	-	0	-	0
17. Secar Rock	0	-	-	0	-	0	-	-	0	-	0
18. Round Rock	0	-	-	0	-	0	-	-	0	-	0
19. Unnamed Is.	0	-	-	0	-	0	-	-	0	-	0
20. Unnamed Is.	0	-	-	0	-	0	-	-	0	-	0
21. Mummy Rock	0	-	-	0	-	0	-	-	32	-	4
22. Islets & Rocks	0	-	-	0	-	0	-	-	0	-	0

Table A-2.--Numbers of harbor seals sighted on aerial surveys of the islands, islets, and rocks of the San Juan Wilderness area, December 1978 through May 1979. - = locality not surveyed, 0 - no animals present. Map reference numbers refer to Figure A-1.--continued.

Map reference number	1978		1979								
	Dec 27	Dec 28	Jan 18	Jan 31	Feb 16	Mar 19	Mar 20	Apr 17	Apr 26	May 22	May 23
23. Shark Reef	0	-	-	0	-	0	-	-	0	-	0
24. Harbor Rock	0	-	-	0	-	0	-	-	0	-	3
25. N. Pacific Rock	0	-	-	0	-	0	-	-	0	-	0
26. Halftide Rock	0	-	-	0	-	0	-	-	9	-	31
27. Unnamed Is.	0	-	-	0	-	0	-	-	0	-	0
28. Low I.	0	-	-	0	-	0	-	-	0	-	0
29. Pole I.	0	-	-	0	-	0	-	-	0	-	0
30. Barren I.	0	-	-	0	-	0	-	-	0	-	0
31. Battleship I.	0	-	-	0	-	0	-	-	0	-	0
32. Sentinel Rock	4	-	-	16	-	22	-	-	32	-	16
33. Center Reef	0	-	-	0	-	0	-	-	0	-	0
34. Gull Reef	0	-	-	0	-	0	-	-	0	-	0
35. Ripple I.	0	-	-	13	-	57	-	-	41	-	51
36. Shag Reef	0	-	-	0	-	0	-	-	0	-	0
37. L. Cactus I.	8	-	-	24	-	0	-	-	0	-	0
38. Gull Rock	0	-	-	0	-	0	-	-	0	-	0
39. Flattop I.	0	-	-	0	-	0	-	-	0	-	0
40. White Rock	0	-	-	12	-	22	-	-	13	-	30
41. Mouatt Reef	0	-	-	0	-	0	-	-	0	-	0
42. Skipjak I.	0	-	-	1	-	0	-	-	29	-	52
43. Unnamed I.	0	-	-	0	-	0	-	-	0	-	0
44. Clements Reef	0	-	-	0	-	0	-	-	0	-	0
45. Unnamed I.	2	-	-	88	-	44	-	-	89	-	107
46. Parker Reef	0	-	-	0	-	0	-	-	0	-	0

Table A-2.--Numbers of harbor seals sighted on aerial surveys of the islands, islets, and rocks of the San Juan Wilderness area, December 1978 through May 1979. - = locality not surveyed, 0 = no animals present. Map reference numbers refer to Figure A-1.--continued.

Map reference number	1978		1979								
	Dec 27	Dec 28	Jan 18	Jan 31	Feb 16	Mar 19	Mar 20	Apr 17	Apr 26	May 22	May 23
47. The Sisters	0	-	-	0	-	0	-	-	0	-	0
48. L. Sister	0	-	-	0	-	0	-	-	0	-	0
49. Unnamed Islet	0	-	-	0	-	0	-	-	0	-	0
50. Tift Rocks	14	-	-	15	-	25	-	-	8	-	18
51. Unnamed Rock	0	-	-	0	-	0	-	-	0	-	0
52. Turn Rock	0	-	-	0	-	0	-	-	0	-	0
53. Shag Rock	0	-	-	0	-	0	-	-	0	-	0
54. Flower I.	0	-	-	0	-	0	-	-	0	-	0
55. Willow I.	0	-	-	0	-	0	-	-	0	-	0
56. Lawson Rock	0	-	-	0	-	0	-	-	0	-	0
57. Pointer I.	0	-	-	0	-	0	-	-	0	-	0
58. Black Rock	0	-	-	0	-	0	-	-	0	-	0
59. Unnamed Rocks	0	-	-	0	-	0	-	-	0	-	0
60. Brown Rocks	0	-	-	0	-	0	-	-	0	-	0
61. Unnamed Rock	0	-	-	0	-	0	-	-	0	-	0
62. S. Peapod Rock	0	-	-	0	-	6	-	-	0	-	0
63. Peapod Rocks	1	-	-	15	-	50	-	-	11	-	9
64. N. Peapod Rock	0	-	-	0	-	20	-	-	0	-	0
65. Eliza Rock	0	-	-	0	-	0	-	-	0	-	0
66. Viti Rock	0	-	-	0	-	0	-	-	0	-	0
67. Dot I.	0	-	-	0	-	0	-	-	0	-	0
68. Unnamed Rock	0	-	-	0	-	0	-	-	0	-	0
69. Unnamed I.	0	-	-	0	-	0	-	-	0	-	0

Table A-2.--Numbers of harbor seals sighted on aerial surveys of the islands, islets, and rocks of the San Juan Wilderness area, December 1978 through May 1979. - = locality not surveyed, 0 - no animals present. Map reference numbers refer to Figure A-1.--continued.

Map reference number	1978		1979								
	Dec 27	Dec 28	Jan 18	Jan 31	Feb 16	Mar 19	Mar 20	Apr 17	Apr 26	May 22	May 23
70. Low I.	0	-	-	0	-	0	-	-	0	-	0
71. Nob I.	0	-	-	0	-	0	-	-	0	-	0
72. Unnamed I.	0	-	-	0	-	0	-	-	0	-	0
73. Unnamed I.	0	-	-	0	-	0	-	-	0	-	0
74. Unnamed Rocks	0	-	-	0	-	28	-	-	25	-	40
75. Smith I.	0	0	0	0	-	0	0	0	-	0	-
76. Minor I.	24	47	83	109	-	187	93	216	-	40	-
77. Matia I.	0	-	-	15	-	29	-	-	0	-	37
78. Puffin I.	0	-	-	0	-	0	-	-	2	-	92
79. Turn I.	0	-	-	0	-	0	-	-	0	-	0
80. Bird Rocks	0	-	-	3	-	8	-	24	11	-	42
81. Williamson Rocks	0	-	-	0	-	-	-	-	0	-	0
82. Colville I.	0	-	-	0	-	0	-	-	0	-	0
83. Buck I.	0	-	-	0	-	5	-	-	13	-	37
84. Bare I.	0	-	-	68	-	22	-	-	12	-	33

Table A-3.--Numbers of harbor seals sighted on aerial surveys of the islands, islets, and rocks of the San Juan Wilderness area, June through August 1979. - = locality not surveyed, 0 = no animals present. Map reference numbers refer to Figure A-1.

Map reference number	1979					
	Jun 21	Jun 22	Jul 9	Aug 6	Aug 7	Aug 8
1. Small I.	0	-	-	0	-	0
2. Unnamed I.	0	-	0	0	-	0
3. Fortress I.	0	-	0	0	-	0
4. Skull I.	0	-	-	0	-	0
5. Crab I.	0	-	-	0	-	0
6. Boulder Is.	0	-	-	0	-	0
7. Davidson Rock	0	-	-	0	-	0
8. Castle I.	0	-	-	0	-	0
9. Unnamed I.	0	-	0	0	-	0
10. Aleck Rocks	0	-	0	0	-	0
11. Swirl I.	0	-	0	0	-	0
12. Unnamed Rock	0	-	0	0	-	0
13. Unnamed Is.	0	-	0	0	-	0
14. Unnamed Is.	0	-	0	0	-	0
15. Hall I.	0	-	0	0	-	0
16. Unnamed I.	0	-	0	0	-	0
17. Secar Rock	0	-	0	0	-	0
18. Round Rock	0	-	0	0	-	0
19. Unnamed Is.	0	-	0	0	-	0
20. Unnamed Is.	0	-	0	0	-	0
21. Mummy Rock	0	-	0	18(1)[1]	-	0
22. Islets & Rocks	0	-	0	0	-	25
23. Shark Reef	0	-	0	0	-	0
24. Harbor Rock	0	-	0	0	-	-
25. N. Pacific Rock	0	0	0	0	-	-
26. Halftide Rock	20	2	18	24(8)	-	-
27. Unnamed Is.	0	-	0	0	-	0
28. Low I.	0	-	0	0	-	0
29. Pole I.	0	-	0	0	-	-
30. Barren I.	0	-	0	0	-	-

Table A-3.--Numbers of harbor seals sighted on aerial surveys of the islands, islets, and rocks of the San Juan Wilderness area, June through August 1979. - = locality not surveyed, 0 - no animals present. Map reference numbers refer to Figure A-1.--continued.

Map reference number	1979					
	Jun 21	Jun 22	Jul 9	Aug 6	Aug 7	Aug 8
31. Battleship I.	0	-	0	0	-	-
32. Sentinel Rock	44	-	50	67(6)[1]	-	-
33. Center Reef	0	-	0	0	-	-
34. Gull Reef	0	-	0	0	-	-
35. Ripple I.	14	-	10	8(2)	-	-
36. Shag Reef	0	-	0	0	-	-
37. L. Cactus I.	0	-	0	10(2)	-	-
38. Gull Rock	0	-	0	0	-	-
39. Flattop I.	0	-	0	0	-	-
40. White Rocks	44	-	20	21(6)	-	-
41. Mouatt Reef	0	-	0	0	-	-
42. Skipjak I.	6	-	47(3)	45(1)	-	-
43. Unnamed I.	0	-	0	0	-	-
44. Clements Reef	0	-	0	0	-	-
45. Unnamed I.	124	-	96	57	-	-
46. Parker Reef	0	-	0	0	-	-
47. The Sisters	0	-	0	0	-	-
48. L. Sister	0	-	0	0	-	-
49. Unnamed Islet	0	-	0	0	-	-
50. Tift Rocks	3	-	0	0	-	-
51. Unnamed Rock	0	-	0	0	-	-
52. Turn Rock	0	-	0	0	-	-
53. Shag Rock	0	-	0	0	-	-
54. Flower I.	0	-	0	0	-	-
55. Willow I.	0	-	0	0	-	-
56. Lawson Rock	0	-	0	0	-	-
57. Pointer I.	-	2	0	0	-	0
58. Black Rock	0	0	0	0	-	-
59. Unnamed Rocks	0	0	0	0	-	-
60. Brown Rocks	0	0	0	0	-	-
61. Unnamed Rock	0	0	0	0	-	-
62. S. Peapod Rock	0	20	0	0	32	-

Table A-3.--Numbers of harbor seals sighted on aerial surveys of the islands, islets, and rocks of the San Juan Wilderness area, June through August 1979. - = locality not surveyed, 0 = no animals present. Map reference numbers refer to Figure A-1.--continued.

Map reference number	1979					
	Jun 21	Jun 22	Jul 9	Aug 6	Aug 7	Aug 8
63. Peapod Rocks	10	28	15	10(4)[1]	35	-
64. N. Peapod Rock	5	10	2	0	4(4)	-
65. Elize Rock	0	-	0	0	-	-
66. Viti Rock	0	0	0	0	-	-
67. Dot I.	0	0	0	0	-	-
68. Unnamed	0	-	-	8(1)	-	-
69. Unnamed I.	0	0	0	0	-	-
70. Low I.	0	0	0	0	-	-
71. Nob I.	0	0	0	0	-	-
72. Unnamed I.	0	0	0	0	-	-
73. Unnamed I.	0	0	0	0	-	-
74. Unnamed Rocks	45	43	0	19(3)	-	-
75. Smith I.	0	0	0	0	0	-
76. Minor I.	118(4)	87(6)	93(13)	194(12)	122(18)	-
77. Matia I.	0	-	20(1)	0	-	-
78. Puffin I.	94	-	103	101(13)	-	-
79. Turn I.	0	-	0	0	-	-
80. Bird Rocks	58	-	64(2)	49(6)	-	61(7)
81. Williamson Rocks	0	-	0	5(1)	-	-
82. Colville I.	0	-	0	0	-	-
83. Buck I.	15	28	26	19(2)	-	-
84. Bare I.	100	-	47(4)	38(3)	-	-

[1] Numbers in ( ) = pups. They are not included in location total.

Table A-4.--Numbers of harbor seals sighted on aerial surveys from northern Puget Sound to Bellingham Bay and the the San Juan Islands (excluding San Juan Wilderness sites), December 1978 through May 1979. - = locality not surveyed, 0 = no animals present. Map reference letters refer to Figure A-2.

Map reference letter	1978		1979								
	Dec 27	Dec 28	Jan 18	Jan 31	Feb 16	Mar 19	Mar 20	Apr 17	Apr 26	May 33	May 23
A. Bellingham Bay	-	-	-	0	-	0	-	-	0	-	0
B. Wildcat Cove	-	-	-	-	-	0	-	-	0	-	0
C. Samish Bay	-	-	-	0	-	0	-	-	46	-	0
D. Padilla Bay	-	-	-	0	-	51	-	26	25	-	21
E. Hat I.	-	-	-	0	-	0	-	-	0	-	0
F. Fidalgo Bay	1	-	-	0	-	0	-	0	-	-	1
G. Sinclair I. (SE)	0	-	-	2	-	0	-	-	0	-	3
H. Boulder Reef	0	-	-	0	-	0	-	-	0	-	30
I. Point Migley	0	-	-	0	-	0	-	-	0	-	22
J. Clark I.	0	-	-	0	-	0	-	-	0	-	0
K. Barnes I.	0	-	-	0	-	0	-	-	10	-	43
L. Echo Bay	0	-	-	0	-	0	-	-	0	-	2
M. Sentinel I.	0	-	-	0	-	0	-	-	0	-	0
N. Satellite I.	0	-	-	0	-	0	-	-	0	-	0
O. Twin Rocks	1	-	-	0	-	27	-	-	32	-	36
P. Bald Bluff	0	-	-	0	-	0	-	-	0	-	0
Q. Blind I.	0	-	-	0	-	0	-	-	0	-	0
R. Bell I.	0	-	-	0	-	0	-	-	0	-	0
S. Leo Reef	0	-	-	0	-	0	-	-	0	-	24
T. Pear Point	0	-	-	0	-	10	-	-	3	-	4
U. Deadman I.	0	-	-	0	-	0	-	-	0	-	0
V. Whale Rocks	0	-	-	0	-	0	-	-	0	-	0
W. Protection I.	21	102	151	157	181	153	115	147	89	73	-
X. Marrowstone I.	0	-	0	-	0	5	-	-	-	11	-
Y. Colvus Rocks	1	-	17	-	0	8	-	0	-	8	-
Z. Port Gamble	3	-	-	9	0	-	3	0	-	-	3

Table A-5.--Numbers of harbor seals sighted on aerial surveys from northern Puget Sound to Bellingham Bay and the San Juan Islands (excluding San Juan Wilderness sites), June through August 1979. - = locality not surveyed, 0 = no animals present. Map reference letters refer to Figure A-2.

Map reference letter	1979					
	Jun 21	Jun 22	Jul 9	Aug 6	Aug 7	Aug 8
A. Bellingham Bay	0	-	-	0	-	-
B. Wildcat Cove	0	-	-	0	-	-
C. Samish Bay	48	-	-	59(12)[1]	-	-
D. Padilla Bay	95	-	-	76(17)	-	-
E. Hat I.	0	2	-	4(1)	-	-
F. Fidalgo Bay	7	-	-	3	-	-
G. Sinclair I. (SE)	1	-	-	4(2)	-	-
H. Boulder Reef	0	54	-	31(3)	-	-
I. Point Migley	0	-	-	-	-	-
J. Clark I.	0	-	0	0	-	-
K. Barnes I.	52	-	0	25	-	-
L. Echo Bay	0	-	48(2)	65(13)	-	-
M. Sentinel I.	0	-	-	0	-	-
N. Satellite I.	0	-	-	0	-	-
O. Twin Rocks	0	34	-	27(4)	-	-
P. Bald Bluff	0	0	-	0	-	-
Q. Blind I.	0	0	-	0	-	-
R. Bell I.	0	0	-	0	-	-
S. Leo Reef	0	33	-	8(2)	-	-
T. Pear Point	5	-	-	21(5)	-	-
U. Deadman I.	0	-	-	0	-	-
V. Whale Rocks	0	-	-	0	-	-
W. Protection I.	178	131	126	106(10)	65(4)	133(9)
X. Marrowstone I.	-	0	-	-	14	-
Y. Colvus Rocks	16	-	-	8	9	-
Z. Port Gamble	0	-	-	-	-	3

---

[1] Numbers in ( ) = pups. They are not included in location total.

Table A-6.--Numbers of harbor seals sighted on aerial surveys from the Strait of Juan de Fuca, December 1978 through May 1979. - = locality not surveyed, 0 = no animals present. Map reference numbers refer to Figure A-2.

Map reference number	1978		1979								
	Dec 27	Dec 28	Jan 18	Jan 31	Feb 16	Mar 19	Mar 20	Apr 17	Apr 26	May 22	May 23
Olympic Peninsula											
1. Kiapot Point	0	0	0	0	0	0	0	0	-	-	-
2. Kulakala Point	0	0	0	0	0	0	26	0	-	42	-
3. Dungeness Refuge	0	64	0	0	5	70	52	21	35	65	-
4. Green Point	0	0	0	0	0	0	0	0	-	-	-
5. Low Point	-	0	5	-	18	-	3	6	-	5	-
6. Deep Creek	-	0	0	-	3	-	13	0	-	0	-
7. Pillar Point	-	0	0	-	-	-	0	0	-	0	-
8. Seal Rock	-	0	0	-	-	-	5	7	-	0	-
9. Tatoosh I.	-	0	0	-	-	-	0	0	-	0	-
Vancouver Island											
10. Chain I.	57	-	85	-	14	59	70	52	-	119	-
11. Trail I.	0	-	27	-	17	2	11	0	-	0	-
12. Race Rocks	0	0	27	59	12	78	134	125	60	90	-
13. Becher Bay	-	0	0	-	20	-	49	15	-	18	-
14. Possession Point	-	0	0	-	-	-	0	0	-	0	-
15. Sherringham Point	-	0	0	-	-	-	0	0	-	0	-
16. Jordan R.	-	0	0	-	-	-	0	0	-	0	-
17. Providence Cove	-	0	0	-	-	-	17	0	-	0	-

Table A-7.--Numbers of harbor seals sighted on aerial surveys from the Strait of Juan de Fuca, June through August 1979. - = locality not surveyed, 0 = no animals present. Map reference numbers refer to Figure A-2.

Map reference number	1979					
	Jun 21	Jun 22	Jul 9	Aug 6	Aug 7	Aug 8
Olympic Peninsula						
1. Kiapot Point	0	-	0	0	0	0
2. Kulakala Point	0	-	5	0	28	5 (4)
3. Dungeness Refuge	24	-	0	50 (14)[1/]	60 (27)	36 (8)
4. Green Point	0	-	0	0	0	0
5. Low Point	-	0	-	-	-	40 (6)
6. Deep Creek	-	10	-	-	-	23 (2)
7. Pillar Point	-	0	-	-	-	0
8. Seal Rock	-	2	-	-	-	2
9. Tatoosh I.	-	0	-	-	-	0
Vancouver Island						
10. Chain I.	0	153	-	-	176 (18)	-
11. Trail I.	0	38	-	-	54 (5)	48 (6)
12. Race Rocks	80	-	-	-	118	167 (28)
13. Becher Bay	-	25	-	-	49 (6)	0
14. Possession Point	-	0	-	-	-	0
15. Sherringham Point	-	0	-	-	-	0
16. Jordan R.	-	0	-	-	-	0
17. Providence Cove	-	8	-	-	-	50 (2)

[1/] Numbers in ( ) = pups. They are not included in location total.

TABLE A-8.--Sighting reports of northern elephant seals (Mirounga angustirostris) in Puget Sound the San Juan Islands and the Strait of Juan de Fuca, by month.

Date	Time	No.	Location	Comments	Source[1/]
January					
1/24/79	-	1	Murden Cove Bainbridge I.	dead (SJJ-2054)	S. Jeffries (files)
April					
4/21/63	1630	1	1/2 m W of Edmonds	First state record; adult male	Scheffer and Kenyon (1963)
4/ -/72	-	1	New Dungeness Light	#994 (Año Nuevo)	(files)
4/ 8/73	-	1	Becher Bay, Vancouver I.	Male stranded alive, recovered by Sealand of the Pacific, Ltd., escaped 5/13/73	J.G. Colby (files)
4/11/75	-	1	Victoria, B.C.	#2006 (Año Nuevo)	M. Bigg (files)
4/22/75	-	1	Point Wilson		S. Guill (files)
4/28/75	-	1	Point Wilson		S. Guill (files)
4/27/76	1530	1	Admiralty Inlet	Subadult male	H.L.
4/27/76	1743	1	off Yeomalt Point Bainbridge I.	Subadult male	H.L.
4/10/77	-	1	Discovery Bay	Present for 3-4 days; 7' molting female; #3433 (Año Nuevo)	A. Barrie (files)
4/19/78	-	1	Dallas Bank		J. Sweat (files)
4/19/79	-	1	between Partridge Bank and Pt. Wilson		S. Wilson (files)
4/19/79	-	1	N. Foulweather Bluff		S. Wilson (files)
May					
Spring 1970	-	1	Cape Flattery	Dead, date unknown #897 (Año Nuevo)	(files)
5/27/70	-	1	Edmonds - Possession Point		Seattle PI(2[illegible]ay 1970)

TABLE A-8.--Sighting reports of northern elephant seals (*Mirounga angustirostris*) in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca, by month. - continued.

Date	Time	No.	Location	Comments	Source1/
May					
5/24/72	-	1	Sequim Bay	#1207 or #1067 (Año Nuevo)	(files)
5/ 7/76	1420	1	N. of Slip Point	Subadult male	H.L.
5/15/76	2015	1	Speiden Channel	Subadult male	H.L.
5/30/77	1200	1	Blakely Rock, off Bainbridge I.	12-15' length, sex?	A. Barrie (files)
5/ 5/78	1150	1	2 mi. N. of Foulweather Bluff, Whidby I.		R. Murphy (POP)
5/ ?/78	-	1	Violet Point, Protection I.	Hauled out on spit near harbor seals	M. Pitherick (POP)
5/13/79	-	1	Waadah I.	dead	P. Gearin (files)
5/13/79	-	1	N. Picnic Point		POP
5/16/79	-	1	Neah Bay		H.L.
5/16/79	-	1	Pt. Townsend		H.L.
5/16/79	-	1	Active Pass		H.L.
5/29/79	-	1	1/2 mi. W. Point Roberts	eating dogfish	G. Kelsey (files)
July					
7/72	-	1-2	N. Edmonds		Game
August					
8/27/75	1530	1	Turn Point, Stuart I.	Adult male	J.E. Mandaville(files)
8/26/77	-	1	1/4 mi. W. of Smith I.	Observed w/fish in mouth	C. Linden (files)

TABLE A-8.--Sighting reports of northern elephant seals (*Mirounga angustirostris*) in Puget Sound, the San Juan Islands and the strait of Juan de Fuca, by month.--continued.

Date	Time	No.	Location	Comments	Source[1/]
September					
9/2/68	1730	1	1.5 mi. NW of Edmonds	Adult male; second Washington record	Craddock (1969)
9/10/79	-	1	North of Golden Gardens		B. Patten (files)
October					
10/8/75	1935	1	N. of Kingston Point	Adult male	E. Osterhaug (files)
10/26/78	-	1	E. of Pilot Point	Adult male	E. Long (POP)
10/25/79	-	1	off Koitlah Point		R. Everitt (files)
10/26/79	-	1	Admiralty Inlet	Adult male	R. Everitt (files)
December					
12/78	-	1	N. Meadow Point		S. Wilson (files)

[1/] From the files of the National Marine Mammal Laboratory (files), from the Platforms of Opportunity Program (POP), from Orca survey - Hotline (H.L.), from Washington Department of Game (Game).

TABLE A-9.--Sighting reports of gray whales (Eschrichtius robustus) in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca, by month.

Date	Time	No.	Location	Comments	Source[1/]
January					
1/7/77	-	1	Green Point		H.L.
1/2/78	1340	1	Elliott Bay, Pier 69		H.L.
1/20/78	PM	1	Rich Passage, Bainbridge I.		H.L.
1/20/78	PM	1	Sinclair Inlet		H.L.
1/24/78	1600	1	Tacoma Narrows		H.L.
1/6/79	-	1	off Alki Point	heading south	Game
1/12/79	1610	1	Port Angeles		H.L.
1/26/79	-	1	north of Ketron I.		H.L.
February					
2/2/78	-	2	Port Gamble		H.L.
March					
3/30/76	-	1	Clam Bay, Rich Passage	tentative I.D.	POP
3/1/78	1040	2	Port Gamble		H.L.
3/2/78	-	2	Port Gamble		H.L.
3/3/78	-	2	Port Gamble		H.L.
3/4/78	-	2	Port Gamble		H.L.
3/5/78	-	2	Port Gamble		H.L.
3/9/78	1530	1	Wing Pt., Bainbridge I.		H.L.
3/10/78	1230	1	Point Defiance		H.L.
3/25/78	0900	1	off Edmonds		H.L.
3/8/79	1200	1	Liberty Bay		H.L.
3/9/79	1300	1	Bainbridge I.		H.L.
3/9/79	1630	1	Bolin Point		H.L.
3/10/79	0930	1	Agate Pass		H.L.
3/10/79	1200	1	Bangor		H.L.

TABLE A-9.--Sighting reports of gray whales (Eschrichtius robustus) in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca, by month.--continued.

Date	Time	No.	Location	Comments	Source[1/]
April					
4/24/77	PM	2	Budd Inlet		H.L.
4/26/77	-	2	Eld Inlet	Tentative I.D.	H.L.
4/30/77	-	1-2	Budd Inlet		H.L.
4/2/78	-	1	Green Point		H.L.
4/9/78	0630	1	Hammersley Inlet		H.L.
4/9/78	1230	5	5 mi. n. Clallam Bay		H.L.
4/9/78	-	1	Colvus Passage, Vashon I.		H.L.
4/14/78	-	1	Port Angeles		J.Brueggeman (files)
4/6/78	-	1	Point Wilson		files
May					
5/14/77	-	1	Hammersley Inlet		H.L.
5/15/77		1	Hammersley Inlet		H.L.
5/23/78	2145	1	Elliott Bay		H.L.
5/24/78	0600	1	Green Point		H.L.
5/24/78	1400	1	Bush Point		H.L.
5/24/78	1530	1	Alki		H.L.
5/26/78	0800	2	Commencement Bay		H.L.
5/ /78	-	1	Dungeness Spit	heading east	Game
5/6/79	-	Herd	Hood Canal		H.L.
5/9/79	1500	15	Port Townsend		H.L.
5/29/79	1730	1	Neah Bay	tangled in gillnet and released	T. Gornall (files)
June					
6/15/77	-	1	Hammersley Inlet		H.L.
6/1/78	-	2	Point No Point		H.L.
6/1/78	1800	1	Possession Point		H.L.
6/24/78	0830	1	Chuckanut Bay		H.L.
6/24/78	0835	1	Chuckanut Bay		H.L.
6/24/78	0900	1	Chuckanut Bay		H.L.
6/28/78	0930	1	Viti Rock, Lummi I.	tentative I.D.	H.L.
6/22/79	1400	1	San Simeon point, B.C.		(files)

TABLE A-9.--Sighting reports of gray whales (Eschrichtius robustus) in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca, by month.--continued.

Date	Time	No.	Location	Comments	Source[1/]
July					
7/11/76	1200	1	Partridge Point, Whidbey I.		H.L.
7/1/78	1010	1	Sinclair Inlet		H.L.
7/2/78	1240	1	Point No Point		H.L.
7/8/78	-	1	Hale Passage Lummi I.		H.L.
7/22/79	0830	2	E. of Tatoosh I.		G. Harrv (files)
7/29/79	1500	1	Green Point		H.L.
August					
8/14/76	2100	1	Bush Point	tentative I.D.	H.L.
8/24/76	1600	1	Victoria, B.C.	tentative I.D.	H.L.
8/29/76	1100	1	Elliott Bay	tentative I.D.	H.L.
8/29/76	1400	1	Robinson Point	tentative I.D.	H.L.
8/31/76	1200	1	Carr Inlet	tentative I.D.	H.L.
8/29/78	1413	1	Seal Rock E. of Neah Bay	resting at surface	(files)
8/3/78	AM	1	Three Tree Point		H.L.
8/5/78	-	1	Off Tacoma		H.L.
September					
9/2/76	1045	2	Dalco Passage		H.L.
9/3/76	1000	1	Dana Passage		H.L.
9/3/76	1130	1	Budd Inlet		H.L.
9/3/76	1315	1	Hunter Point		H.L.
9/5/76	AM	1	Olele Point, Oak Bay		H.L.
9/6/76	0609	1	S. Fox I.		H.L.
9/12/76	0730	1	Three Tree Point		H.L.
9/9/77	-	1	Rich Passage		H.L.
9/9/77	-	1	Sinclair Inlet		H.L.
9/10/77	-	1	Sinclair Inlet		H.L.
9/14/78	-	1	Neah Bay	dead	(files)
9/8/79	-	2	Neah Bay		H.L.
9/10/79	-	1	Elliot Bay		H.L.

TABLE A-9.--Sighting reports of gray whales (Eschrichtius robustus) in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca, by month.--continued.

Date	Time	No.	Location	Comments	Source[1]
October					
10/12/76	1535	1	Poverty Bay		H.L.
10/13/78	-	1	Dungeness Spit		(files)
10/14/78	1400	1	Friday Harbor		H.L.
10/12/79	1130	1	Vashon Island		H.L.
10/13/79	0930	1	Port Washington Narrows		H.L.
10/15/79	1030	1	Silverdale		H.L.
10/20/79	1100	1	Bremerton		H.L.
10/21/79	1700	1	Port Washington Narrows		H.L.
November					
11/8/77	-	1	Ediz Hook		H.L.
December					
12/4/76	-	1	Gooseberry Point, Lummi Point		H.L.
12/16/78	1015	1	Elliot Bay		H.L.

[1] From the files of the National Marine Mammal Laboratory (files, from the Platforms of Opportunity Program (POP), from Orca Survey - Hotline (H.L.), from Washington Department of Game (Game).

TABLE A-10.--Sighting reports of minke whales (*Balaenoptera acutorostrata*) in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca, by month.

Date	Time	No.	Location	Comments	Source[1/]
January					
1/27/78	1035	1	Gig Harbor		H.L.
March					
3/29/78	0748	1	Andrews Bay		H.L.
3/11/76	-	1	Nisqually R.	dead	S. Jeffries (files)
3/8/79	1345	1	Cattle Point		H.L.
April					
4/22/76	1427	1	Hein Bank		H.L.
4/29/76	1830	2	Salmon Bank		H.L.
4/10/78	1400	1	Tacoma Narrows		H.L.
4/14/78	1600	1	Shaw I., San Juan Channel		H.L.
4/15/78	1400	1	N. Camano I.		H.L.
4/22/78	1730	1	Sandy Point, Waldron I.		H.L.
4/30/78	0930	1	Cattle Pass		H.L.
4/30/78	1300	1	Cattle Pass		H.L.
4/12/78	-	1	Partridge Bank		(files)
4/25/79	1345	1	S. of Sucia I.		H.L.
May					
5/1/76	1610	1	Cattle Pass		H.L.
5/7/78	1400	1	Boundary Pass		H.L.
5/31/78	1300	1-2	Possession Point		H.L.
5/31/78	2000	1-2	Sachet Head, Whidbey I.		H.L.
June					
6/2/76	1505	1	Partridge Bank		H.L.
6/2/76	1520	1	Partridge Bank		H.L.
6/14/76	1115	1	Hein Bank		H.L.
6/17/78	1200	2	Hein Bank		H.L.

TABLE A-10.--Sighting reports of minke whales (Balaenoptera acutorostrata) on Puget Sound, the San Juan Islands and the Strait of Juan de Fuca, by month.--continued.

Date	Time	No.	Location	Comments	Source[1/]
July					
7/6/65	-	1	W. San Juan I.		Fiscus & Kajimura (1965)
7/7/65	-	2	San Juan Channel		Fiscus & Kajimura (1965)
7/7/65	-	3	San Juan Channel, Shaw I.		Fiscus & Kajimura (1965)
7/8/65	-	1	San Juan Channel		Fiscus & Kajimura (1965)
7/8/65	-	2	San Juan Channel		Fiscus & Kajimura (1965)
7/9/65	-	2	San Juan Channel, Turn I.		Fiscus & Kajimura (1965)
7/9/65	-	1	N. San Juan Channel		Fiscus & Kajimura (1965)
7/9/65	-	1	Speiden Channel		Fiscus & Kajimura (1965)
7/9/65	-	1	Griffin Bay to Cattle Point		Fiscus & Kajimura (1965)
7/10/65	-	2	San Juan Channel		Fiscus & Kajimura (1965)
7/11/65	-	2	Partridge Point		Fiscus & Kajimura (1965)
7/12/65	-	1	San Juan Channel		Fiscus & Kajimura (1965)
7/14/65	-	3	San Juan Channel		Fiscus & Kajimura (1965)
7/2/76	1005	2	S.W. Smith I.		H.L.
7/2/76	1507	1	Haro Strait		H.L.
7/25/76	1500	2	S. Haro Strait	tentative I.D.	H.L.
7/28/76	1105	2	Cattle Point		H.L.
7/29/76	0925	1	Speiden Channel	tentative I.D.	H.L.
7/30/76	0600	1	off Friday Harbor	tentative I.D.	H.L.
7/4/78	1430	1	Ebbey Landing		H.L.
7/15/78	1400	1-2	Skipjack I.		H.L.
7/15/78	1630	1	E. Smith I.		H.L.
7/17/78	-	1	Limestone Point, SJI		H.L.
7/19/78	0912	1	Partridge Bank		This study
7/19/78	0955	1	Speiden Channel		This study
7/19/78	1130	2	Possession Point		H.L.
7/19/78	AM	1	Speiden I.		H.L.
7/19/78	PM	1	Partridge Bank		H.L.
7/8/78	0930	1	Andrews Bay		H.L.
7/17/78	1500	1	Speiden I.		H.L.
7/21/78	1610	1	Middle Bank		H.L.
7/22/78	1828	1	Salmon Bank		H.L.
7/23/78	1350	2	Hein Bank		H.L.
7/25/78	0900	1	Pile Point		H.L.
7/29/78	1230	2	Salmon Bank		H.L.

TABLE A-10.--Sighting reports of minke whales (*Balaenoptera acutorostrata*) in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca, by month. --continued.

Date	Time	No.	Location	Comments	Source[1/]
August					
8/5/76	1835	1	Speiden Channel	tentative I.D.	H.L.
8/9/76	2100	1	W. Jones I.	tentative I.D.	H.L.
8/10/76	1120	1	Salmon Bank		H.L.
8/14/76	1600	1	E. Sucia I.	tentative I.D.	H.L.
8/14/76	1820	1	W. Matia I.		H.L.
8/17/76	1040	2	W. Smith I.		H.L.
8/24/76	1730	1	W. Shaw I.	tentative I.D.	H.L.
8/24/76	2030	1	N. Barnes I.	tentative I.D.	H.L.
8/29/76	1200	1	Speiden Channel	tentative I.D.	H.L.
8/3/77	1359	1	Partridge Bank		(files)
8/5/78	1400	1	Whale Rocks		H.L.
8/8/78	0930	1	Andrews Bay		H.L.
8/9/78	0810	2	Sidney I.		H.L.
8/12/78	1430	1	Blakely I.		H.L.
8/29/79	1615	1	Hein Bank		H.L.
8/23/79	PM	2	West Strait		W. Pearson(files)
September					
9/2/76	1547	1	President's Channel		H.L.
9/5/76	1840	1	Speiden Channel		H.L.
9/5/76	1900	1	Kellet Bluff		H.L.
9/6/76	0700	1	Hansville		H.L.
9/6/76	1430	1	Waldron I.		H.L.
9/9/76	1217	1	N. James I.	tentative I.D.	H.L.
9/10/76	0655	1	off Bremerton	tentative I.D.	H.L.
9/10/76	0912	1	Middle Point, Rich Passage	tentative I.D.	H.L.
9/10/76	1100	1	James I.		H.L.
9/10/76	1130	1	E. Middle Point	tentative I.D.	H.L.
9/11/76	1411	2	Battleship Rock		H.L.
9/13/76	1345	1	E. Deception Pass	tentative I.D.	H.L.
9/14/76	1600	1	Speiden Channel	tentative I.D.	H.L.
9/16/76	1330	1	Speiden Channel	tentative I.D.	H.L.
9/17/76	1700	2	W. Speiden I.		H.L.

TABLE A-10.--Sighting reports of minke whales (Balaenoptera acutorostrata) in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca, by month. --continued.

Date	Time	No.	Location	Comments	Source[1]
September (cont.)					
9/17/76	1950	1	N. Speiden I.	tentative I.D.	H.L.
9/20/76	1300	2	N. Speiden I.	tentative I.D.	H.L.
9/20/76	1540	1	Hansville	tentative I.D.	H.L.
9/21/76	1745	1	Limestone Point, SJI		H.L.
9/24/76	1300	1	W. Smith I.		H.L.
9/25/76	1648	1	N. Henry I.		H.L.
9/27/76	1300	2	Speiden Channel	tentative I.D.	H.L.
9/29/76	1500	1	S. Waldron I.	tentative I.D.	H.L.
9/30/76	1250	1	N. Speiden I.	tentative I.D.	H.L.
9/10/77	1340	1	Griffin Bay		(files)
9/10/77	1354	2-3	off Lime Kiln Point		(files)
9/1/78	1328	1	Deadman's Cove		H.L.
9/2/78	1210	2	Hein Bank		H.L.
9/4/78	1545	1	Hein Bank		H.L.
9/4/78	1735	1	Hein Bank		H.L.
9/5/78	1819	1	Deadman's Cove		H.L.
9/11/78	1145	1	Ripple I.		H.L.
9/12/78	1900	1	Griffin Bay		H.L.
9/17/78	1300	1	Point No Point		H.L.
9/17/78	1920	1	Lawrence Point		H.L.
9/18/78	1500	1	Edmonds		H.L.
9/18/78	1600	1	Cattle Pass		H.L.
9/22/78	1147	1	Andrews Bay		H.L.
9/27/78	1800	1	Turn Point		H.L.
October					
10/2/76	1345	1	Point No Point	tentative I.D.	H.L.
10/4/76	1825	1	N.E. Speiden I.		H.L.
10/5/76	0900	1	Hansville	tentative I.D.	H.L.
10/8/76	1845	1	Point No Point	tentative I.D.	H.L.
10/16/76	1715	1	Point No Point	tentative I.D.	H.L.
10/20/76	1310	1	S.W. Jones I.	tentative I.D.	H.L.

TABLE A-10.--Sighting reports of minke whales (Balaenoptera acutorostrata) in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca, by month.--continued.

Date	Time	No.	Location	Comments	Source[1/]
October (cont.)					
10/1/78	0700	1	Eagle Point		H.L.
10/1/78	1630	1	Speiden Channel		H.L.
10/6/78	1345	1	Speiden I.		H.L.
10/6/78	1045	1	Andrews Bay		H.L.
10/8/78	0940	1	Andrews Bay		H.L.
10/9/78	-	1	Turn I.		H.L.
10/19/78	-	1	Jones I.		H.L.
10/19/78	1640	1	Turn I.		H.L.
10/21/78	1651	1	Cactus I.		H.L.
10/25/78	1630	1	Upright Channel		H.L.
10/23/79	0746	1	Yellow I.		This study
10/23/79	0820	1	North of Sentinel I.		This study
10/23/79	0825	1	Northwest of Speiden I.		This study
December					
12/20/76	1425	1	W. Hat I.	tentative I.D.	H.L.
12/7/78	1200	1	Turn I.		H.L.
12/9/78	1500	1	Mud Bay		H.L
12/9/78	1500	1	Pear Point		H.L.
12/26/78	1600	1	Iceberg Point		H.L.

[1/] From the files of the National Marine Mammal Laboratory (files), or from Orca survey - Hotline (H.L.)

TABLE A-11.--Sighting reports of harbor porpoise (Phocoena phocoena) in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca, by month.

Date	Time	No.	Location	Comments	Source[1/]
January					
1/26/78	1052	8	S.W. Matia I.	feeding, tide rips	This study
1/10/80	1212	3	Lat 48°17.8'N, Long 123°17.7'W	10 miles NW of Dungeness Lt.	This study
February					
2/26/78	1500	10	Bellevue Point, SJI		H.L.
2/18/78	-	2	Green Point		Mesa
2/4/79	-	2	Deception Pass		Game
March					
3/10/78	-	4	S. Shaw Is.		Mesa
3/16/78	-	1	Pillar Point		Mesa
3/16/78	-	2	Freshwater Bay		Mesa
April					
4/3/76	1015	7	Peapod Rocks		H.L.
4/25/76	1207	20	Sandy Point, Waldron I.		H.L.
4/28/76	1809	1	Dungeness Spit		H.L.
4/2/77	-	2	Gooch I., B.C.		H.L.
4/3/78	1830	1	Andrews Bay, S.J.I.		H.L.
4/23/78	1810	3-5	Sandy Point, Waldron I.		H.L.
4/29/78	1630	7-15	Limekiln Point, San Juan I.		H.L.
4/30/78	1000	4-5	Limekiln Point, San Juan I.		H.L.
May					
5/1/76	1635	1	San Juan Channel		H.L.
5/5/76	1411	1	Sister Rks., Clark I.		H.L.
5/6/76	1608	4	Peapod Rks		H.L.
5/7/76	1053	2	Off Port Angeles		H.L.
5/15/76	1926	4	McCracken Point		H.L.
5/23/76	1320	5	Boiling Reef		H.L.
5/7/78	1030	1	Cattle Pass		H.L.
5/8/78	-	8	Burrows I.		Mesa
5/19/78	1240	1	Bird Rocks, Rosario St.		H.L.
5/29/78	1300	3	Middle Bank		H.L.
5/29/78	1530	2	Iceberg Point		H.L.
5/23/79	-	?	W. Barnes I.		Game

TABLE A-11.--Sighting reports of harbor porpoise (Phocoena phocoena) in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca, by month.--continued.

Date	Time	No.	Location	Comments	Source[1/]
June					
6/7/76	1440	2	Presidents Channel		H.L.
6/7/76	1607	2	Peapod Rocks		H.L.
6/7/76	1645	1	Rosario Point		H.L.
6/18/76	1710	1	Battleship Rock		H.L.
6/22/76	1231	1	Speiden Channel		H.L.
6/27/76	1706	2	Patos I.		H.L.
6/27/76	1725	1	Boiling Reef, Saturna I.		H.L.
6/2/78	1500	2	Rosario St.		H.L.
6/4/78	0930	2	Andrews Bay, SJI		H.L.
6/4/78	-	4	Burrows I.		Mesa
6/11/78	1650	1	Andrews Bay, SJI		H.L.
6/30/78	2000	2	Andrews Bay, SJI		H.L.
6/3/79	1300	5	West Bank		H.L.
6/9/79	0930	3-5	Turn I.		H.L.
July					
7/3/65	-	3	Waldron I.		Fiscus & Kajimura (1965)
7/6/65	-	1	Point Francis		"
7/6/65	-	4	Bellingham Channel		"
7/6/65	-	2	Bird Rocks		"
7/6/65	-	2	Boulder I.		"
7/7/65	-	1	San Juan Channel		"
7/8/65	-	1	Speiden Channel		"
7/8/65	-	1	N.E. Speiden I.		"
7/9/65	-	1	San Juan Channel		"
7/9/65	-	1	E. Speiden I.		"
7/9/65	-	1	W. Speiden I.		"
7/9/65	-	2	Pile Point, SJI		"
7/9/65	-	2	Griffin Bay		"
7/10/65	-	1	Rosario Strait		"
7/10/65	-	1	Cypress I.		"
7/10/65	-	2	Bellingham Channel		"
7/10/65	-	1	Eliza I.		"
7/11/65	-	4	Clark Point, Guemes I.		"
7/11/65	-	8	Rosario Strait		"
7/12/65	-	1	Point Hammond, Waldron I.		"
7/13/65	-	2	Boundary Bay		"

TABLE A-11.--Sighting reports of harbor porpoise (*Phocoena phocoena*) in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca, by month.--continued.

Date	Time	No.	Location	Comments	Source[1/]
July					
7/14/76	1504	1	Skipjack I.		H.L.
7/14/76	1605	1	Waldron I.		H.L.
7/1/78	1500	3-5	Bird Rocks		H.L.
7/16/78	1530	3	S. Peapod Rocks	Tentative I.D.	H.L.
7/21/78	2020	1	Partridge Bank		This study
7/21/78	1510	2	Pile Point, San Juan I.		H.L.
7/22/78	1700	3	Devil's Head	Tentative I.D.	H.L.
7/22/78	-	3-5	Johnson Point		Game
7/23/78	0944	3-4	N. Protection I.		This study
7/27/78	-	1	Shilshole Bay, Puget Sound		H.L.
7/27/78	1806	7	Patos I., Boundary Pass, SJI		H.L.
7/29/78	1825	2-4	Samish Bay		H.L.
August					
8/1/76	1405	1	Mid-Channel		H.L.
8/31/76	1650	1	Turn Point, Stuart I.		H.L.
8/6/77	-	2	Discovery I.		H.L.
8/14/77	-	2	Rosario Strait		H.L.
8/17/77	-	2	False Bay, Haro Strait		H.L.
8/3/78	0745	5	Turn Point, Stuart I.		H.L.
8/3/78	0830	4	Apple Tree Cove, Puget Sound		H.L.
8/4/78	-	1	Point Roberts		H.L.
8/6/78	-	1	Birch Bay		Mesa
8/7/78	2020	8-10	Andrews Bay, San Juan I.		Mesa
8/8/78	0900	5	Andrews Bay, San Juan I.		H.L.
8/8/78	1930	5	Pile Point, San Juan I.		H.L.
8/16/78	-	1	Pillar Point		H.L.
8/16/78	-	1	N. Sequim Bay		Mesa
8/30/78	1745	4-6	False Bay, San Juan I.		Mesa
8/31/78	1725	4-5	Limekiln Point, San Juan I.		H.L.

TABLE A-11.--Sighting reports of harbor porpoise (*Phocoena phocoena*) in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca, by month.--continued.

Date	Time	No.	Location	Comments	Source[1]
September					
9/2/76	1253	1	S. San Juan I.		H.L.
9/15/76	1209	2	N.E. Waldron I.		H.L.
9/19/76	1300	2	Hein Bank		H.L.
9/20/76	1215	1-2	Monarch Hd., Saturna I.		H.L.
9/5/77	-	5	Turn Point, Stuart I.		H.L.
9/6/77	-	2	James I.		H.L.
9/10/77	1310	1	Cattle Point		(files)
9/12/77	-	2	Cattle Point		H.L.
9/6/78	1608	2-3	Deadman's Cove, San Juan I.		H.L.
9/11/78	1835	2	Deadman's Cove, San Juan I.		H.L.
9/11/78	0920	1-2	Freshwater Bay		(files)
9/12/78	-	3	Pillar Point		Mesa
9/13/78	1832	3	Deadman's Cove, San Juan I.		H.L.
9/14/78	-	1	Protection I.		Mesa
9/24/78	1914	2-3	Deadman's Cove, San Juan I.		H.L.
October					
10/5/76	1245	2	Middle Bank		H.L.
10/3/78	1925	3	Limekiln Point, San Juan I.		H.L.
10/5/78	0915	3-4	Andrews Bay, San Juan I.		H.L.
10/5/78	1730	2-3	Andrews Bay, San Juan I.		H.L.
10/24/79	0832	2	E. of Port Angeles		This study
10/25/79	1727	2	W. of Ediz Hook		This study
November					
11/8/79	1630	20	NW Port Angeles		This study
December					
12/8/77	0936	1	Bird Rocks		This study

---

[1] From the files of the National Marine Mammal Laboratory (files), Orca survey - Hotline (H.L.), Washington Department of Game (Game) and the MESA Marine Bird Project (Mesa).

TABLE A-12.--Sighting reports of Dall's porpoise (Phocoenoides dalli) in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca, by month.

Date	Time	No.	Location	Comments	Source[1/]
January					
1/12/78	-	6-8	Anderson I.		Game
1/19/78	-	2	Thatcher Pass		Mesa
1/7/79	1230	6	Penrose Point		H.L.
1/26/79	-	6-8	Ketron I.		H.L.
1/8/80	1335	2	W. of Partridge Bank		This study
1/10/80	1056	1	Off Ediz Hook		This study
February					
2/17/78	1700	1	Lopez I.		H.L.
2/11/79	0945	8	Port Townsend		H.L.
2/22/79	1415	11-15	Marrowstone Point		H.L.
March					
3/17/77	0930	5	Budd Inlet		H.L.
3/16/78	-	2	Tatoosh Island, Strait of Juan de Fuca		Mesa
3/16/78	-	6	Dallas Bank		Mesa
3/8/79	1345	many	Cattle Point		H.L.
3/10/79	1300	20	NW Henry I.	feeding	H.L.
3/11/79	0930	3	Sunset Point		H.L.
3/31/79	0900	5	Andrews Bay, SJI		H.L.
3/31/79	1730	20-25	N. Waldron Is.		H.L.
April					
4/5/76	1330	6-10	S.E. of Chain Is.		H.L.
4/5/76	1420	20	5 mi N of Pt. Angeles		H.L.
4/8/76	0730	15	E of Ediz Hook		H.L.
4/8/76	1015	10	E of Pt. Angeles		H.L.
4/21/76	1500	5	E of Saturna I.		H.L.
4/26/76	1910	3-4	Hall I. (near Lopez I.)		H.L.
4/27/76	1425	2	Iceberg Point	Bow ride	H.L.
4/27/76	1440	8	Iceberg Point	Bow ride	H.L.
4/29/76	1105	4	Strait of Juan de Fuca		H.L.
4/29/76	1755	5	Salmon Bank		H.L.

TABLE A-12.--Sighting reports of Dall's porpoise (Phocoenoides dalli) in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca, by month.--continued.

Date	Time	No.	Location	Comments	Source[1/]
April					
4/1/78	-	1	Point Wilson		Mesa
4/10/78	-	2	Peapod Rock		Mesa
4/10/78	-	4	Barnes I.		Mesa
4/14/78	-	13	Off "A" Buoy, Strait of Juan de Fuca		H.L.
4/23/78	-	2	1/2 mi N Sucia I.		H.L.
4/25/78	1020	4	Partridge Bank		This study
May					
5/12/76	1900	8	1/2 mi E of Sucia I.		H.L.
5/18/78	1320	5	Partridge Bank		This study
5/20/78	1445	2-4	Thatcher Pass		H.L.
5/26/78	2100	2	Point No Point		H.L.
5/29/78	AM	3	Middle Bank		H.L.
5/30/78	PM	6	Race Rocks, Strait of Juan de Fuca		H.L.
5/31/78	0800	3-6	Scatchet Head, Whidbey I.		H.L.
5/27/79	1050	3+	NW Smith I	feeding	P. McGuire (files)
5/27/79	1720	3	Point Lawrence		P. McGuire (files)
June					
6/1/78	1030	2	Steilacoom		H.L.
6/3/78	1530	2	Johnson Point		H.L.
6/4/78	0600	5	Johnson Point		H.L.
6/4/78	0830	2	Andrews Bay , SJI		H.L.
6/4/78	2000	4-5	San Juan Channel		H.L.
6/6/78	-	5	Marrowstone I.		H.L.
6/11/78	1836	1	Johnson Point		H.L.
6/17/78	2000	6-7	Possession Point		H.L.
6/20/78	1500	4	Point Wilson		H.L.
6/23/78	1045	2-4	Marrowstone I.		H.L.
6/25/78	1100	2	Possession Point		H.L.
6/3/79	1030	3-5	NE Orcas I.		H.L.
6/14/79	1830	15	N. Limekiln Point		H.L.
6/16/79	1345	7	Andrews Bay , SJI		H.L.

TABLE A-12.--Sighting reports of Dall's porpoise (*Phocoenoides dalli*) in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca, by month.--continued.

Date	Time	No.	Location	Comments	Source[1]
July					
7/7/76	1030	2	W. Smith I.	Tentative I.D.	H.L.
7/18/76	1000	6	Lagoon Point, Whidbey I.	Tentative I.D.	H.L.
7/20/76	1700	2	E. Patos I.	Tentative I.D.	H.L.
7/23/76	1530	6-8	N.W. Smith I.		H.L.
7/29/76	1300	2	Admiralty Inlet		H.L.
7/31/76	0900	5	Point Jefferson		H.L.
7/6/77	-	6	Carl Bay		H.L.
7/29/77	-	15	-		H.L.
7/6/78	1430	6-7	Admiralty Inlet		H.L.
7/9/78	1400	3-4	Point No Point		H.L.
7/13/78	0700	10-20	Possession Point		H.L.
7/17/78	1500	6	Admiralty Point		H.L.
7/18/78	1800	2	Off Mukilteo		H.L.
7/19/78	1237	2	S. Race Rocks		This study
7/19/78	1335	6	S. Useless Bay		This study
7/21/78	0745	1	Mitchell Bay, SJI		H.L.
7/22/78	0800	3	Off Edmonds		H.L.
7/25/78	2000	8-15	Case Inlet		H.L.
7/27/78	1036	1	N.E. Dungeness Refuge		This study
7/29/78	1415	3	Bush Point		H.L.
7/31/78	-	20	Double Bluff		H.L.
7/31/78	1500	1	Case Inlet		H.L.
7/29/79	-	6	Appletree Point		S. Knapp (files)
7/30/79	-	6	Appletree Point		S. Knapp (files)
August					
8/7/76	1508	3	Point No Point	Tentative I.D.	H.L.
8/11/76	1400	4	Off Richmond Beach	Tentative I.D.	H.L.
8/17/76	1015	4	Cattle Point, SJI	Tentative I.D.	H.L.
8/18/76	1600	2	Point No Point	Tentative I.D.	H.L.
8/28/76	1610	1	Partridge Bank		H.L.
8/29/76	1550	3-5	Dungeness Spit		H.L.
8/29/76	1630	1	3 mi NE Port Angeles, Strait of Juan de Fuca		H.L.
8/29/76	1645	2	4 mi NE Port Angeles, Strait of Juan de Fuca		H.L.
8/29/76	1655	2	Off Crescent Bay, Strait of Juan de Fuca		H.L.

TABLE A-12.--Sighting reports of Dall's porpoise (*Phocoenoides dalli*) in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca, by month.--continued.

Date	Time	No.	Location	Comments	Source[1]
October					
10/24/79	0840	5	W. Angeles Point,	Strait of Juan de Fuca	This study
10/25/79	0755	1	W. Tatoosh Island	"	This study
10/25/79	1457	8	W. Pillar Point	"	This study
10/25/79	1520	4	E. Pillar Point	"	This study
10/25/79	1549	3	Twin River	"	This study
10/25/79	1625	3	Tongue Point	"	This study
November					
11/30/78	1357	2	N. Cape Flattery	"	This study
11/6/79	1250	6	Neah Bay	"	This study
11/6/79	1300	2	Koitlah Point	"	This study
11/8/79	0600	2	Tatoosh Island	"	This study
11/8/79	1039	4	Tatoosh Island	"	This study
11/8/79	1433	19	E. Pillar Point	"	This study
11/8/79	1435	9	E. Pillar Point	"	This study
11/8/79	1605	6	E. Crescent Bay	"	This study
December					
12/4/79	1425	4	Neah Bay	"	This study
12/5/79	0955	4	NW Kydaka Point	"	This study
12/5/79	1208	1	E. Pillar Point	"	This study
12/5/79	1210	4	E. Pillar Point	"	This study
12/5/79	1522	1	Off Dungeness Spit		This study

---

[1] From the files of the National Marine Mammal Laboratory (files), Orca survey - Hotline (H.L.), Washington Department of Game (Game), and the MESA Marine Bird Project (Mesa).

TABLE A-12.--Sighting reports of Dall's porpoise (Phocoenoides dalli) in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca, by month.--continued.

Date	Time	No.	Location	Comments	Source[1/]
September					
9/7/76	1945	1	Discovery I.		H.L.
9/16/76	1144	1-2	W. San Juan I.		H.L.
9/19/76	1515	2	Middle Bank		H.L.
9/29/76	1600	3-6	Double Bluff, Whidbey I.		H.L.
9/1/77	-	1	Smith I.		H.L.
9/4/77	-	5	Admiralty Inlet		H.L.
9/5/77	-	6-7	Point No Point		H.L.
9/5/77	-	4	Langley Point, Fidalgo I.		H.L.
9/10/77	-	3	Thatcher Pass		H.L.
9/23/77	-	6-10	Possession Head		H.L.
9/6/78	1000	6-8	Bush Point		W.B. McAlister (files)
9/7/78	1815	4-5	Eagle Hbr.		H.L.
9/9/78	0900	6	Picnic Point		H.L.
9/10/78	1700	6-8	2 mi off Point No Point	Bow ride	(files)
9/10/78	1000	6	Picnic Point		H.L.
9/12/78	1500	6-7	Jefferson Head		H.L.
9/12/78	-	3	Neah Bay		Mesa
9/18/78	1500	5	Edmonds		H.L.
9/19/78	1149	5+	Useless Bay		H.L.
9/24/78	1200	5-7	Possession Point		H.L.
9/25/78	1740	2	N. Edmonds	feeding	(files)
9/29/78	1600	4-5	Alki Point		H.L.
October					
10/15/76	1605	3-4	Bush Point, Whidbey I.		H.L.
10/13/76	-	6	Double Bluff, Whidbey I.		(files)
10/2/78	1400	4	N. Tatoosh I Strait of Juan de Fuca		(files)
10/3/78	1430	3	N. Freshwater Bay		(files)
10/4/78	1630	2-3	NE Marrowstone I.		H.L.
10/6/78	AM	5-6	Cowichan Bay		H.L.
10/7/78	PM	6-7	Shilshole Bay		H.L.
10/12/78	1130	2	Vashon I.		H.L.
10/16/78	1055	3	S. Bush Point		(files)
10/20/78	-	2	Port Gardner		(files)
10/31/78	-	6	Point Wilson		(files)

TABLE A-12.--Sighting reports of Dall's porpoise (*Phocoenoides dalli*) in Puget Sound, the San Juan Islands and the Strait of Juan de Fuca, by month.--continued.

Date	Time	No.	Location	Comments	Source[1]
August					
8/16/77	-	10-12	Protection I.		H.L.
8/17/77	-	1	Burrows Bay		H.L.
8/25/77	-	10-12	Admiralty Inlet (Skunk Bay)		H.L.
8/3/78	1700	8-12	Hartstene I.		H.L.
8/4/78	0630	3-5	Double Bluff		H.L.
8/4/78	0800	2+	Possession Point		H.L.
8/4/78	1318	12-16	Marrowstone I.		H.L.
8/4/78	1325	4-8	Marrowstone I.		H.L.
8/4/78	1345	2-3	Marrowstone I.		H.L.
8/5/78	1100	5-6	Scatchet Head		H.L.
8/5/78	1930	6-7	Port Williams		H.L.
8/6/78	0710	5-6	Point No Point		H.L.
8/6/78	0845	-	Double Bluff		H.L.
8/12/78	-	-	Double Bluff		H.L.
8/12/78	1130	6-7	Columbia Beach		H.L.
8/12/78	1530	1	W. Smith I.		H.L.
8/13/78	1230	-	Hein Bank		H.L.
8/16/78	-	1	Dungeness Spit		Mesa
8/17/78	1100	20-30	Bush Point		H.L.
8/17/78	1615	-	Discovery I.		H.L.
8/18/78	1113	2	Harney Channel		This study
8/19/78	1537	-	Discovery I.		H.L.
8/23/78	2045	5-6	Admiralty Inlet (Bush Point)		R.L. DeLong (files)
8/26/78	1600	10	Scatchet Head		H.L.
8/28/78	1130	2	Kellet Bluff		H.L.
8/28/78	1500	8-28	Henderson Bay		H.L.
8/8/79	-	6	Eagle Hbr.		C. Gallup (files)
8/6/79	-	1	Shaw I.	dead in gillnet	L. Jones (files)
8/25/79	1630	6-8	Off Shilshole		T. Gornall (files)

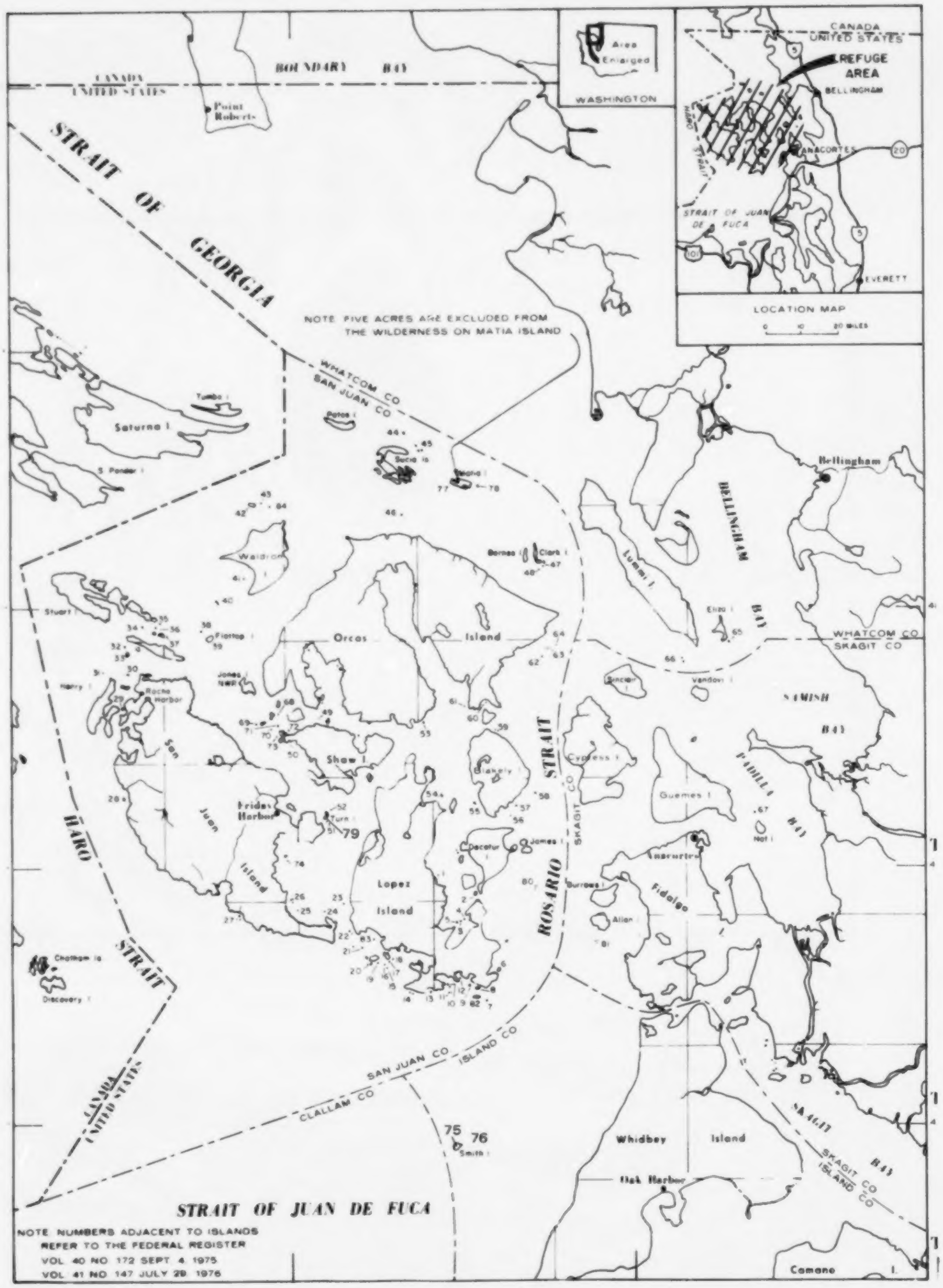
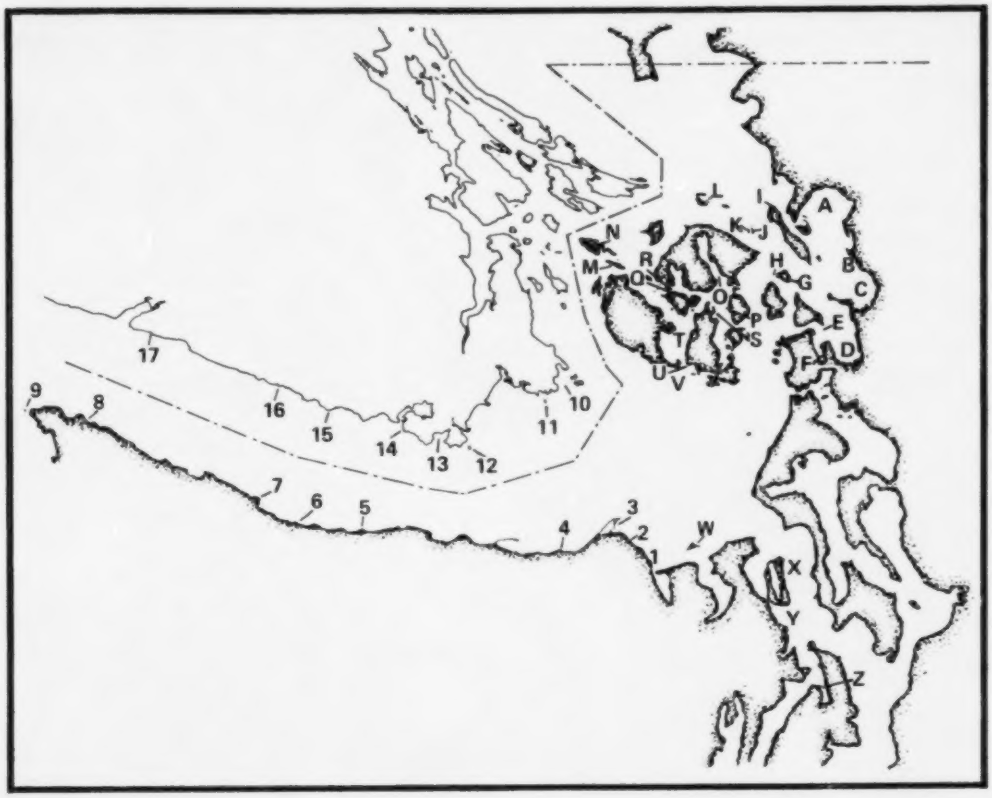

CANADA
UNITED STATES
BOUNDARY BAY
Point Roberts
Area Enlarged
WASHINGTON
CANADA
UNITED STATES
REFUGE AREA
BELLINGHAM
ANACORTES
20
5
STRAIT OF JUAN DE FUCA
101
EVERETT
LOCATION MAP
0 10 20 MILES
STRAIT OF GEORGIA
NOTE FIVE ACRES ARE EXCLUDED FROM THE WILDERNESS ON MATIA ISLAND
WHATCOM CO
SAN JUAN CO
Tumbo I.
Saturna I.
S. Pender I.
Patos I.
Sucia Is.
Matia I.
Waldron
Barnes I.
Clark I.
Orcas Island
Stuart I.
Flattop I.
Jones NWR
Henry I.
Roche Harbor
San Juan Island
Friday Harbor
Turn I.
79
Shaw
Blakely I.
Decatur I.
James I.
Lopez Island
Lummi I.
BELLINGHAM BAY
Bellingham
Eliza I.
WHATCOM CO
SKAGIT CO
Sinclair I.
Vendovi I.
SAMISH BAY
Cypress I.
Guemes I.
PADILLA BAY
Hat I.
Anacortes
Fidalgo
Burrows I.
Allan I.
ROSARIO STRAIT
SKAGIT CO
HARO STRAIT
Chatham Is.
Discovery I.
CANADA
UNITED STATES
SAN JUAN CO
ISLAND CO
CLALLAM CO
75
76
Smith I.
Whidbey Island
Oak Harbor
SKAGIT BAY
SKAGIT CO
ISLAND CO
STRAIT OF JUAN DE FUCA
Camano I.
NOTE NUMBERS ADJACENT TO ISLANDS REFER TO THE FEDERAL REGISTER
VOL 40 NO 172 SEPT 4 1975
VOL 41 NO 147 JULY 29 1976

Figure A-1. Locations of islands, islets, and rocks of the San Juan Wilderness area.



A
L
I
K
J
N
R
H
B
M
Q
G
C
O
P
E
T
S
D
F
17
U
V
9
8
10
16
15
11
14
13
12
7
6
5
3
4
2
W
1
X
Y
Z

Figure A-2. Locations of Harbor seal (*Phoca vitulina richardsi*) haul out sites from northern Puget Sound to Bellingham Bay, the San Juan Islands (excluding San Juan Wilderness sites) and the Strait of Juan de Fuca.

APPENDIX B

A description of harbor seal sampling units in northern Puget Sound, the San Juan Islands, the eastern bays, and the Strait of Juan de Fuca. See Figure 2 for location of units.

A narrative summary of each sampling unit, expanded from the 1977-78 data presented in Everitt et al. (1979) to include 1979 data, is included in Appendix B. Numbers in parenthesis refer to sampling unit. See Figure 2 for location.

Cherry Point to Point Roberts (Unit 1)

No hauling sites are known in this unit from the literature or the present study. Since this unit borders population concentrations immediately to the south, undoubtedly some harbor seals can be expected to forage here, although to what extent is unknown. Tidal areas in Lummi Flats produce suitable habitat for harbor seals and they might be expected to occasionally haul out there.

Bordering the northern limit of this unit (U.S.-Canadian Border) is Boundary Bay (Figure 1), a tideflat area included in a specimen collecting program reported by Bigg (1969b). During the present study one aerial survey was flown over this bay during a low tide on 6 August 1979. A total count of 424 harbor seals plus 39 pups was made by visual and photographic means, which represents the largest single concentration of harbor seals at any one haul out in northern Puget Sound surveyed to date. Undoubtedly, these animals forage south of Boundary Bay into U.S. waters.

Patos Island to Lummi Island (Unit 2)

Important hauling sites are found on Sucia Island, Matia and Puffin Islands, Barnes Island, and on an offshore islet near Point Migley, Lummi Island. Harbor seals were observed on Clark Island in the fall and winter months.

At Sucia Island two areas are utilized. North of the main island is an unnamed islet which is a part of the San Juan Wilderness Area (map reference number 45, Figure A-1). A second location in Echo Bay (map reference L, Figure A-2) is utilized irregularly during the winter and spring months. However, animals were regularly seen at this second site only during the summer breeding season and fall molting season, and this was the only site where pups were observed near Sucia Island. Wilson (1973) suggests that pups are commonly born on "nursery sites" away from the non-breeding population and this may be the use made of the Echo Bay site. Harbor seals all but abandon Matia Island in summer, shifting to Puffin Island which was little used in winter and spring. There is a possibility that harrassment of the Matia Island haul site caused by increased recreational use of the Marine State Park at the west end of the island may be responsible for this movement. A minimum of 26 pups were produced in this area in August 1978. A maximum count of 279 harbor seals in this unit was made in October 1978. This unit accounted for 12.8% of the population in the entire study area in August 1979. As mentioned previously, the highest counts of the year in the study area are obtained in August during the harbor seals' annual molt.

Haro Strait (Unit 3)

This unit includes six hauling sites from Skipjack Island to Sentinal Island. No concentrations of seals are known along the west side of Henry Island or San Juan Island, though they occur there singly in the water and a few harbor seals occasionally haul out in Andrews Bay (R. Osborne, pers. commun.).

All of the hauling sites are in the San Juan Wilderness system, which affords some measure of protection to these animals, except on Sentinal Island where animals occasionally haul out instead of, or in addition to, its offshore rocks, which are a part of the system. Most of the harbor seals in Haro Strait are found on the islands and reefs north of Sentinal Island. Few pups were observed here during aerial surveys; however, during a small boat survey on 30 September 1978 at least 20 weaned pups were observed. Total pup production in Haro Strait was probably higher since older pups may have been mistaken for immature animals.

The high count for this unit was 208 animals obtained in October 1978. Haro Strait accounted for 9.8% of the maximum population estimate for the entire study area in August 1979.

San Juan Islands (Unit 4)

This unit includes the interior waters on either side of Haro and Rosario Straits. Nine hauling sites are found here, most animals being observed south of Lopez Island where disturbance from pleasure craft may be minimal. A group of 50 animals was monitored near Dinner Island by Mr. and Mrs. D. Ward of Bellevue, Washington, who kindly provided us with information on that area.

All hauling sites except Twin Rocks (East Sound, Orcas Island) are protected as part of the San Juan Wilderness Area. The location where the most pups (21) were born in the San Juan Islands was on the unnamed rocks off Dinner Island (map reference number 74, Figure A-1). Suckling was observed apart from the nonbreeding animals at this site (M. Ward pers. commun.).

The high count of harbor seals obtained for Unit 4, including pups, was 386 in August 1978. Unit 4 contained 8.1% of the high count for the study area in 1979.

Rosario Strait (Unit 5)

Five hauling sites were located in Rosario Strait during this study, including Williamson Rocks in Burrows Bay, although animals were observed there only in August; four to six harbor seals are seen in Burrows Bay throughout the year (D. Lively, pers. commun.). Of the five sites, all of which are part of the San Juan Wilderness Area, Bird Rocks and Peapod Rocks are the most important, animals being observed at these rocks on all surveys. Our observation during the past 3 years suggests that seasonal movement may occur into and out of Rosario Strait. A maximum count of 197 harbor seals was made in Rosario Strait in August 1978. Unit 5 contained 8.7% of the maximum population counted in 1979. Some pupping occurs on the Rosario Strait haul sites; the largest number counted during a single survey was 21 in August 1978.

Bellingham Bay to Padilla Bay (Unit 6)

This unit includes Guemes and Cypress Islands and Fidalgo Bay, in addition to the larger bays. Seven hauling sites are located here. Of these, only Eliza Rock is a part of the San Juan Wilderness Area. Tide flats in Samish and Padilla Bays are isolated from most boat traffic and perhaps as a result are the most important locations in terms of number of animals hauling out. In Fidalgo Bay, seals were observed hauling out on anchored log booms.

Most of the animals in Unit 6 were found in Padilla Bay. The irregularity of occurrence in Samish and Bellingham Bays suggest that seals may move into and out of these bays from other areas, perhaps following fluctuating food resources.

The highest count obtained in this unit was 169 in September 1978. The August 1979 count of 140 in Unit 6 represents 7.6% of the total for the study area. Pupping occurs in Area 6 mostly in Padilla and Samish Bays; in 1979, 32 pups were observed.

Regular observations of seabirds were made from a fixed point in Bellingham Bay by observers of the MESA funded seabird project (S. Speich, pers. commun.). Harbor seals were regularly reported during these observation periods in greater numbers than we observed from the air (Table B-1) indicating greater use of Bellingham Bay than our data implies. The highest count reported by these researchers was 57 on 6 September 1978 coincident with the molting period.

Table B-1.--Counts of harbor seals in Bellingham Bay, Washington by MESA seabird study observers (S. Speich, pers. commun.).

Date	No. of animals
9 February 1978	5
9 March 1978	1
4 May 1978	1
31 May 1978	7
18 July 1978	23
10 August 1978	40
6 September 1978	57
3 November 1978	15

Smith-Minor Islands (Unit 7)

Smith Island and Minor Island are a part of the San Juan Wilderness Area administered by the Nisqually Wildlife Refuge, U.S. Fish and Wildlife Service, Olympia, Washington. Access is strictly controlled. An automated Coast Guard lighthouse stands on the western side of Smith Island, and an automated light and horn are located on the east end of Minor Island. A few harbor seals haul out on the offshore rocks and beaches of Smith Island but the major haul site is on Minor Island. At extreme low tide it is possible to walk across a spit from island to island. Minor Island is a low, narrow island of sand, gravel, and cobblestone. The highest eastern end remains above the water at all times whereas the part extending toward Smith Island may be partially awash during high storm tides.

Seals haul out on either side of Minor Island west of the light, although during the pupping season females with newly born pups were most often observed near the light; the animals were apparently unaffected by the regular blast of the horn.

The harbor seal population at Smith-Minor Islands has increased since the observations of Newby (1973a) during 1965-72 when he counted-estimated the population to be 150 animals. In 1977, Calambokidis et al. (1978) obtained their highest count (245) in August. Our highest count during the 1978-79 surveys was 257 in February 1978. In August 1979, we counted 222 animals (194 adults and immatures, 18 pups), a number that compares favorably with the August 1977 count of Calambokidis. In 1978, Smith-Minor Islands produced 25.8% of the pups seen in the entire study area.

During our surveys of Smith-Minor Islands we saw the first harbor seal pups on 27 June in 1978 and 22 June in 1979. We saw the largest number of pups (44) here in July 1978 and the last obvious pup on 29 August 1978. No last day data were obtained in 1979. Pupping and suckling lasts from late June into September at Smith-Minor Islands.

The average number of animals seen by season for all surveys (regardless of the influence of tide and weather on the counts) is: fall - 117; winter - 148; spring - 109; and summer - 171. Differences between any one survey may be attributable to varying environmental conditions; however, the data does suggest a reasonably stable population throughout the year.

Smith-Minor Islands have been a part of the National Wildlife Refuge system since 1915 and require a special use permit from the USFW before visits can be made. Despite this protection uninformed people still land on the islands, overfly them below legal minimum altitude and otherwise disturb nesting birds and harbor seals. During our aerial surveys we noted disturbances to seals as follows. On 23 and 25 May 1978, aerial surveys were flown over the islands. Many small sport fishing boats were observed close to the islands. No seals were hauled out and only about 25 were seen in nearby waters. On 21 July 1978, during a small boat survey of the islands, we observed hauled out harbor seals at Minor Island flee into the water when a sport fishing boat ventured too close in to the island; on 14 September 1978, two people were observed on Minor Island. No seals were seen on or near Minor Island and only two in the water near Smith Island. In August 1979, 10% of the entire study area population was found here.

Skagit Bay to Port Susan (Unit 8)

Includes the protected waters from Deception Pass southeast to Port Susan and southwest to Rocky Point, Whidbey Island. Aerial surveys were flown through this area infrequently, usually when local fog on the western side of Whidbey Island forced our approach to northern Puget Sound from the eastern side.

During a small boat survey from Deception Pass to Goat Island on 26 May 1978, three harbor seals were observed in the water near Hope Island. No seals were seen in Skagit Bay on boat surveys made 27 May and 3 to 4 September 1978. Ten harbor seals were observed hauled out on the southern tide flats in Skagit Bay in August 1978 during an aerial survey. In August 1979, 24 adults and 3 pups were seen in this same area indicating that some pupping occurs here.

There are probably more harbor seals in this area than our surveys revealed. Ninety seals were reported in Skagit Bay from yearly observations (1970 to 1972) (Newby 1973a). Calambokidis et al. (1978) reported 14 harbor seals in Skagit Bay on 23 October 1977. Victor Yoshino (pers. commun.) reported that a small group of harbor seals (3-5) are regularly seen near Oak Harbor, Whidbey Island, Washington. In August 1979, 1.2% of the entire study area population was found here.

Point Wilson to the Hood Canal Bridge (Unit 9)

Extends from Point Wilson on the Quimper Peninsula south to Port Gamble Bay and includes both sides of Marrowstone Island. Three hauling sites were found in this area; unnamed rocks off the western side of Marrowstone Island, Colvus rocks, and anchored log booms in the southern end of Port Gamble.

During aerial surveys on 12 September and 14 October 1978, 28 and 36 seals, respectively, were hauled out on rafted logs in Port Gamble; all were in molt. The inclusion of these counts into the Unit 9 summary resulted in the highest total estimates for October (49) and September (31) 1978. Reports from local residents at Cape George, Washington suggest that some harbor seals can be found in Port Gamble year-round.

Harbor seals were observed regularly on Colvus Rocks from December to March. From April to July the only observations made were of two animals on 23 May 1978, and one on 28 June 1978. On 18 August 1978 nine animals were observed, and seals were regularly seen through October. These observations suggest seasonal movements away from these rocks in the spring and summer. The western side of Marrowstone Island was not surveyed until March 1978; however, from then until the conclusion of aerial surveys, seals were regularly seen at this haul site.

In August 1979, 29 harbor seals were counted in Unit 9 representing 1.3% of the entire count in the study area for that month.

Protection Island (Unit 10)

Located off the entrance to Discovery Bay, Protection Island ranks second in importance as a harbor seal haul site in the study area (Minor Island is first). Seals haul out almost exclusively on Violet Point (southern spit), although when disturbed some animals may move to Kanem Point on the southwestern end of the island (see figure 16, pg. 73 in Everitt et al. 1979).

During the pupping season, females with newly born pups usually haul out on the northern side of Violet Point, west of the main group of seals. This site was abandoned by the time of weaning. The first pups were observed by the third week of July, and newly born pups were seen until early September, a pupping and suckling period lasting about 6-8 weeks.

Calambokidis et al. (1978) reported their highest count of seals on Protection Island in September 1977. During the present study the highest count we obtained (223 animals) was made in October 1978 of which at least 60% were in molt. In August 1979, the month of the highest count for the entire study area, 133 harbor seals were counted here representing 6.9% of the total for the study area. The most pups that were counted here during 1978 and 1979 was 30 taken from land in August 1979.

Protection Island is presently undergoing commercial development. Except for a portion of the western end (including Kanem Point) which is state-owned and managed as a wildlife sanctuary, the island is subjected to severe human pressure. Disturbance of harbor seals was most evident during summer weekends when the island is most heavily used by lot owners and small boat traffic in surrounding waters is greatest. A summary of data gathered on disturbance was presented earlier in the harbor seal section of the report. In addition to the threat of disturbance posed to harbor seals on Protection Island, a large number of sea bird colonies may also be in jeopardy. Manuwal et al. (1979) reported Protection Island as the principal seabird nesting site in northern Puget Sound, providing nesting habitat for 90% of the seabirds of the area.

Dungeness to Sequim Bay (Unit 11)

Unit 11 extends from Sequim Bay north to and including all of the Dungeness National Wildlife Refuge. During aerial surveys of Dungeness Bay, the coastline south to Kiapot Point (entrance to Sequim Bay) was surveyed. These surveys were not usually carried out very far into Sequim Bay. Of the few small boat surveys to Dungeness, Sequim Bay was examined as time, fuel reserves, and weather allowed. Five boat surveys were made in Unit 11 (March, April, July, and August 1978 and August 1979). Only two regularly used haul sites were found in Unit 11. The first is located usually on the southern side of Dungeness spit near the entrance to Dungeness Bay and a rarely used site off Kulakala Point. Seals were regularly observed in Dungeness Bay but few regularly haul out in the bay itself.

On only one occasion were harbor seals observed inside Sequim Bay. On 15 March 1978 an estimated 35 seals were seen in the water inside Kiapot Point. Considering the proximity of Sequim Bay to large harbor seal populations at Protection Island and Dungeness Bay Refuge, we expect some animals regularly enter this bay. Conversations with local sport fishermen indicated that it is not uncommon to see single harbor seals inside Sequim Bay. Calambokidis et al. (1978) reported 36 harbor seals hauled out on the tide flats off Kulakala Point in September 1977. During the present study animals were seen near this point in all seasons, usually in the water. Hauled-out seals were observed on 28 January 1978. Pups were observed only once, on 19 July 1978, when two mother-pup pairs were seen together in the water.

The Dungeness National Wildlife Refuge (Dungeness Bay) represents an important sanctuary for harbor seals. Animals were most often observed in the water east of Graveyard Spit. The regular presence of small pleasure boats in the locality may limit daytime hauling activity here. The highest count for the Dungeness Bay locality was made during an aerial survey in May 1979, when 107 harbor seals were counted. The expanse of shallow water and shoals limited the effectiveness of boat surveys in the Refuge.

Pups were first seen at Dungeness on 27 July 1978. The highest count of pups (31) was made on an aerial survey in August 1979. The last identifiable pups were observed the last week of August. The number of pups observed here in 1979 rates Dungeness (Unit 11) as important to the reproductive success of harbor seals in northern Puget Sound as are Smith-Minor Islands and Protection Islands.

Of the total count for August 1979 for the entire study area, this unit accounted for 4.6% of the harbor seal population.

Angeles Point to Green Point (Unit 12)

Stretches from just west of Dungeness to Angeles Point, (west of Port Angeles, Washington). Single harbor seals were seen in the water from June through August during aerial surveys of this unit. Two pups were sighted in the unit during our surveys, one with its mother was hauled out near Angeles Point and the other was sighted in the water near Green Point.

Because of restrictions to low flying aircraft near Port Angeles, no surveys were made in the immediate vicinity of the town.

In Port Angeles harbor, seals haul out on rafted logs in a pulp mill holding area in the eastern end of the harbor. Harbor seals were observed at this location during point censuses of seabirds conductd by the MESA seabird project (S. Speich, pers. commun.). Additional observations of this area were made during surveys from the NOAA research vessel John N. Cobb in the fall and winter, 1979 (Table B-2). Counts indicate that over 40 harbor seals are resident in this area during the fall (molting) season.

Table B-2.--Observations of harbor seals in Port Angeles Harbor, 1978-79.

Date	No. of animals	Source
6 April 1978	6	J. Brueggeman, U of W
25 August 1978	18	S. Speich, MESA
15 September 1978	28	S. Speich, MESA
29 November 1978	43	S. Speich, MESA
24 October 1979	22	John N. Cobb
25 October 1979	17	John N. Cobb
8 November 1979	5	John N. Cobb

Pillar Point to Angeles Point (Unit 13)

Harbor seals in this unit, which includes Freshwater Bay and Crescent Bay, were observed to haul out in three general areas: Low Point, Deep Creek, and Pillar Point. The offshore rocks, exposed at low tide near Low Point, were the locality most heavily utilized.

Harbor seals were observed here at all seasons, although they were in greatest abundance from late August through November. Increased haul out during the molt may partially account for the abundance of seals here in fall; however, it seems more likely that they follow schooling fishes into this area, which are abundant here in the fall.

The August 1979 count of 63 harbor seals in this unit represents 3.3% of the estimate for the entire study area that month. Pups were observed here only in August 1979 (8 pups), verifying usage of Unit 13 for pupping and breeding activities.

Neah Bay to Pillar Point (Unit 14)

This unit extends from Pillar Point to Koitlah Point, (west of Neah Bay). It was surveyed monthly during all survey periods. The only harbor seals observed were a small group that occasionally hauled out on Seal Rock located about 2 miles east of Neah Bay. Two harbor seals were observed here in August 1979.

Cape Flattery - Tatoosh Island (Unit 15)

Cape Flattery and Tatoosh Island were the westernmost limit of the MESA study area. Harbor seals were observed in this unit only once. On 19 August

1978, three seals were seen hauled out on rocks offshore from Tatoosh Island. As many as 2,000 harbor seals are found on the outer coast of Washington from Destruction Island to Cape Flattery (Johnson and Jeffries, 1977).

During a series of aerial surveys of the Washington coast north of Grays Harbor in 1976-77 performed under contract for NMML, observers regularly saw harbor seals hauled out on most suitable rocks and islets from Fuca's Pillar south to Ozette Island, with the largest number being seen at the Cape Alava-Ozette locality. No pups were seen at Tatoosh Island during that study. Observations of single animals were regularly made at Tatoosh Island through the spring and summer months in 1979 (D. Boersma, pers. commun.).

Cervantes Point to Sooke Bay (Unit 16)

This unit includes the coastline along the southwestern end of Vancouver Island, British Columbia. The only location where harbor seals were observed hauling out was on offshore rocks near Providence Cove and immediately east of Sombrio Point. The highest count for these two haul sites was 50 taken in August 1979, representing 2.6% of the seals observed in the entire study area. In June and July 1978, a few single harbor seals were observed off Possession Point, Sherringham Point, and the Jordan River in the water. Two pups were observed in Unit 16 in August 1979.

Becher Bay to Discovery Island (Unit 17)

Extends from Becher Bay to Discovery Island, British Columbia, and includes Race Rocks, Chain Islets, and Bentinck Island which are the three most commonly used hauling sites. Other localities where harbor seals were observed are Trial Island and small islets in Becher Bay.

The numbers of harbor seals at Race Rocks increased in the spring and summer from a low in the fall and winter. The spring-summer increase corresponds to the decrease in numbers of sea lions at Race Rocks in the spring, and their increase in fall suggests that competition for hauling space may limit the numbers of harbor seals that are here in winter.

Chain Islets are a series of tidal rocks and islets off Victoria, B.C. A sizable population of harbor seals resides here throughout the year. A concentration of seals (high count was 144 in July 1978) this close to a major metropolitan area is unique in the study area. No more than three pups were ever observed in this unit at any one time; however, aerial surveys tend to underestimate numbers of pups since their small size often makes them difficult to spot. If pups were produced here in any number, we would expect to observe them more frequently This unit may contain a higher percentage of non-breeding animals than elsewhere in the study area or may suffer a higher pup mortality or reproductive dysfunction, perhaps associated with the close proximity to large human populations.

The highest count of harbor seals for this unit (446) was taken in August 1979 and represented 23.1% of all seals counted in the study area, the highest percent of the total for any unit.